PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS

Mechanical testing
Non-destructive testing
Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged order of their U.D.C. numbers, which are printed at the head of the Abstract on the right. Abstracts on a particular subject can be located by first consulting the abridged tables of the U.D.C. published with t January number, or the Annual Alphabetical Subject Index, and then referring to the appropriate U.D.C number in the text. The main headings are listed above.

[*Continued on page 3 of cov*

MATHEMATICS 51

511.13

820. Twenty exact factorials between 304! and 401! UHLER, H. S. *Proc. Nat. Acad. Sci., Wash.*, **34**, 407–12 (*Aug.* 15, 1948).

512.25 : 518.12

821. A short account of relaxation methods. FOX, L. *Quart. J. Mech. Appl. Math.*, **1**, 253–80 (*Sept.*, 1948).—The relaxation method is a process of steadily improved approximation for the solution of simultaneous equations, and any problem that can be formulated in terms of simultaneous equations can, theoretically, be solved by this method. The physical basis leading to the title and vocabulary of relaxation is discussed, and the method is presented as a simple mathematical technique. The solution of ordinary simultaneous equations is illustrated by an example, and devices are suggested for increased convergence. Application to the problem of vibrating structures is described, in which Rayleigh's principle and relaxation are used to obtain the frequencies and modes of vibration. The use of finite differences is demonstrated, whereby differential equations are replaced by finite difference equivalents, and the solution of a differential equation is effected by solving a set of simultaneous equations, the unknowns being the values of the required function at pivotal points of a range or ranges of integration. Attention is focused on partial differential equations of the second order in two variables, and practical details are illustrated by an example of the solution of Laplace's equation, functional values being specified on a closed boundary. The application to other partial differential equations, including the biharmonic equation and the equations of vibration of membranes and of flat plates, is briefly considered, and the account ends with a short summary of problems already successfully solved by relaxation methods. A.

517.56

822. The inverse functions of $z = \omega^{-1} \tanh \omega$ and $z = \omega^{-1} \coth \omega$. HILLMAN, A. AND SALZER, H. E. *J. Math. Phys.*, **27**, 202–9 (*Oct.*, 1948).

517.564.3 : 621.318.7

823. Repeated integrals of Bessel functions and the theory of transients in filter circuits. JAEGER, J. C. *J. Math. Phys.*, **27**, 210–19 (*Oct.*, 1948).

517.7 : 621.392.52

824. Numerical computation of the elliptic function sn (mK/n) where m and n are integers. STEWART, J. L. *Commun. Rev.*, **1**, 24–9 (*March*, 1948).—The calculation has application in the design of electrical wave filters having Chebichev behaviour where the value of sn(mK/n) is required to be known to within 1 part in 10^8. P. O.

518.12 : 512.831

825. Rounding-off errors in matrix processes. TURING, A. M. *Quart. J. Mech. Appl. Math.*, **1**, 287–308 (*Sept.*, 1948).—A number of methods of solving sets of linear equations and inverting matrices are discussed. The theory of the rounding-off errors involved is investigated for some of the methods. In all cases examined, including the well-known "Gauss elimination process," it is found that the errors are normally quite moderate, no exponential build-up need occur. Included amongst the methods considered is a generalization of Choleski's method which appears to have advantages over other known methods both as regards accuracy and convenience. This method may also be regarded as a rearrangement of the elimination process. A.

518.12 : 517.512.2

826. The combined use of relaxation methods and Fourier transforms in the solution of some three-dimensional boundary value problems. TRANTER, C. J. *Quart. J. Mech. Appl. Math.*, **1**, 281–6 (*Sept.*, 1948).—A method is proposed whereby, using Fourier transforms, some 3-dimensional boundary value problems are brought within the scope of normal relaxation methods. The method is illustrated by the solution of Poisson's equation inside the region bounded by a right cylinder of any cross-section when values of the unknown function are given on the curved surface and when either (i) values of the function, or (ii) values of its normal gradient are specified over the flat ends. The steady temperature inside a cube when the surface temperature is constant on one face and zero on the remaining faces is worked out as a detailed example. The solution is also sketched in the case of very long cylinders when only one end affects the required function. A.

518.5

827. Extensions in differential analyser technique. MICHEL, J. G. L. *J. Sci. Instrum. Phys. Ind.*, **25**, 357–61 (*Oct.*, 1948).—A mainly new method of interconnecting elements of a differential analyser was recently described by Amble (regenerative connections). In this paper a constructive technique is developed for obtaining the results arrived at by Amble from analytical considerations. On the basis of this new technique, not only are Amble's results systematized and unified, but extensions are developed whereby the possibility of applying regenerative interconnections to any differential analyser problem may be investigated. Apart from Amble's results, examples are given of: (i) the generation of the integral of a quotient; (ii) the solution of differential equations in which the highest order derivative is associated with a non-constant coefficient; (iii) the inversion of functions defined by a differential equation. A.

519.27 : 621.317.1

828. Theory and practice of periodogram analysis of recorder charts, which consist mainly of non-persistent waves. BLUME, H. *Z. angew. Math. Mech.*, **25/27**, 113–18 (*July*, 1947) *In German.*—In practice, curves on recording charts rarely consist of persistent waves; the paper therefore investigates the mathematical conditions of "quasi-persistence" under which periodogram analysis may be used to find the frequencies and amplitudes of curves consisting mainly of non-persistent waves. The methods of analysis for curves of (1) constant frequency and linearly variable amplitude, (2) ditto, but exponentially variable amplitude, and (3) ditto, but arbitrary amplitude are explained. V. W. R.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.6

829. New principle of construction of the spectro-helioscope and the spectroheliograph. BECKER, W. AND TEN BRUGGENCATE, P. *Nachr. Wiss. Göttingen* (*No.* 1) 49–51 (1946) *In German.*—The Hale spectro-helioscope suffers from the disadvantages of a limited field of view, a difference of focus between the centre and the edge of the field of view, and a lateral decrease of light intensity. These disadvantages can be overcome by the use of a silvered polygonal prism, which can be rotated, in the collimated beam. B. A.

523.6 : 521.7

830. Luminosity variations of Encke's comet. LINK, F. *Ann. Astrophys.*, **11** (*No.* 1) 73–6 (1948) *In French.*—Observations from 1786 to 1947 do not show a connection between brightness and the 11-year solar cycle, nor any secular diminution such as the 1 mag./century suggested by Vseviatsky. The rate of change of brightness with solar distance, however, appears to be influenced by the solar activity. D. L. E.

523.67 : 535.322.1

831. Researches on the spectra of comets. DUFAY, J. AND BLOCH, M. *Ann. Astrophys.*, **11** (*No.* 1) 58–72 (1948) *In French.*—The authors claim an accuracy of $\pm 0{\cdot}5$ Å at 4 100 Å for cometary wavelengths measured in spectra from objective prism instruments of short focus and 60° prisms. Application of the method to comet Peltier (1936a) is described in detail, with measured wavelengths of numerous emission features in the region 3 850 to 6 600 Å. D. L. E.

523.72 : 621.396.821

832. Some observations on solar noise. *N.Z. J. Sci. Tech. B*, **29**, 140–1 (*Nov.*, 1947).—An account of some observations on solar noise in the high-frequency spectrum during February 1946, correlated with the sun's azimuth. Frequencies are generally $>$ the max. useable frequency. A.

523.755 : 551.593

833. On the cause of the high temperature of the solar corona with a remark on the light of the night sky. BIERMANN, L. AND TEN BRUGGENCATE, P. *Nachr. Wiss. Göttingen* (*No.* 1) 19–23 (1946) *In German.*—Destruction of interstellar matter entrapped in the outer atmosphere of the sun, and the upper atmosphere of the earth, is suggested as a possible energy source to account respectively for the observed high coronal temperature and the light of the night-sky. D. R. B.

523.832 : 535.322.1

834. Researches on radial velocity measures with the objective prism. III. FEHRENBACH, C. *Ann. Astrophys.*, **11** (*No.* 1) 35–57 (1948) *In French.*—Describes fully the objective prism constructed and gives results for 12 stars in Coma Berenices. Spectra of stars of magnitude 9 can be secured in 2 hours and the result of 3 measures has a mean error of ± 3 km/sec. Errors due to field curvature and off axis images are examined, showing a useful field of 2°. Hopes are expressed that this form of apparatus will secure results for many stars for which information is not yet available. [See Abstr. 2672 (1948)]. E. G. M.

523,841.11

835. On novae of known amplitude. BERTAUD, C. *Ann. Astrophys.*, **11** (*No.* 1) 1–12 (1948) *In French.*—Data for 34 novae appearing since 1843 are collected. Post-novae differ little from pre-novae and are usually irregular variables of small amplitude. The observed amplitudes of outburst show a double frequency maximum at $8^{m}{\cdot}4$ and $11^{m}{\cdot}4$, and are correlated with luminosity at maximum and with speed of decline. Recurrent novae give a relation between amplitude and interval between outbursts which is followed by U Gemi variables and by long-period variables. A. HU

523.851.2 : 523.854.1

836. On the galactic rotation of the globular clusters. PEREK, L. *C.R. Acad. Sci., Paris*, **226**, 1963–4 (*June* 14, 1948) *In French.*

523.87 : 523.82

837. The spectroscopic method of determining absolute magnitudes from cyanogen absorption. PLASSARD, J. *C.R. Acad. Sci., Paris*, **226**, 1508–10 (*May* 10, 1948) *In French.*—An improvement on Lindblad's method is suggested, using measures of the unblended Sr II absorption at 4 077·7 Å to deduce the contribution of Sr II at 4 215·5 Å to the blend with cyanogen at this wavelength, thus giving a more accurate value of the cyanogen absorption. The latter shows good correlation with absolute magnitude (from trigonometrical parallaxes) for 19 out of 21 stars measured. D. L. E.

523.875 : 523.877

838. The continuous spectrum of γ Cass. BARBIER, D. *Ann. Astrophys.*, **11** (*No.* 1) 13–30 (1948) *In French.*—Published gradient observations are used in the detailed analysis of a suggested model of γ Cass which assumes an invariable nucleus with an extended envelope varying in emission and absorption of its own light and that of the nucleus. A relation is given between light intensity at any wavelength in the nucleus and the observed intensity, the constants in the formula being deduced from observational data. The total luminosity of γ Cass. is assumed to be constant. D. L. E.

523.876 : 523.162

839. Spectrographic study of HD 168 607 and HD 168 625. HERMAN, R. *Ann. Astrophys.*, **11** (*No.* 1) 31–4 (1948) *In French.*—Considerable changes are shown to have occurred in these faint Be stars, particularly in the H and He emission, and the absorption lines of Fe III and O II. Strong interstellar absorption lines are present, and the unusual reddening of both stars is probably due chiefly to absorption by the neighbouring M 17. D. L. E.

523.877

840. On a variational method for approximate solutions of the equation of transfer. PECKER, J.-C. *C.R. Acad. Sci., Paris*, **226**, 1889–91 (*June* 7, 1948) *In French.*—The range of integration in Kourganoff's method [Abstr. 19 (1948)] is restricted to finite optical depths. R. A. N.

523.877

841. On the ratio of surface and effective temperatures of stars in radiative equilibrium. PECKER,

I.-C. *C.R. Acad. Sci., Paris*, **226**, 1961–2 (*June* 14, 1948) *In French.*—Assuming that the absorption coefficient κ_μ can be expressed in the form $X(p_e, T)\psi_\nu(T)$, and using Kourganoff's iterative solution of the equation of transfer [Abstr. 1757 (1948)], it is concluded that T_e/T_R is independent of g and of hydrostatic equilibrium. R. A. N.

526.1 : 526.7

842. Geodetic constants and gravity measurements. SOMIGLIANA, C. *Nuovo Cim.*, **5**, 111–20 (*June*, 1948) *In Italian.*—The author gives his own extension of the Clairaut equation and discusses the significance of the differences between calculated and observed values of constants. W. A. R.

527.6

843. Homing and navigational courses of automatic target-seeking devices. YUAN, L. C.-L. *J. Appl. Phys.*, **19**, 1122–8 (*Dec.*, 1948).—A graphical and mathematical analysis is presented. Homing courses for a seeker-to-target speed ratio of >2 are likely to be impractical for target interception. A method for obtaining a constant bearing course (navigational course) is developed. Some special cases of navigational courses have been studied graphically. It is shown that an optimum navigational ratio exists between that which leads to too slow an approach to the desired course and that which leads to instability. Graphical analysis of navigational courses for straight as well as circular target motion is also given. A.

PHYSICS 53

FUNDAMENTALS 530.1

530.12 : 530.145.6 : 531.24

844. The mass-centre in the restricted theory of relativity and its connexion with the quantum theory of elementary particles. PRYCE, M. H. L. *Proc. Roy. Soc. A*, **195**, 62–81 (*Nov.* 12, 1948).—The Newtonian definition of the mass-centre can be generalized to the restricted theory of relativity in several ways. Three in particular lead to fairly simple expressions in terms of instantaneous variables for quite general systems. Of these only one is independent of the frame in which it is defined. It suffers from the disadvantage that its components do not commute (in classical mechanics, do not have zero Poisson brackets), and are therefore unsuitable as generalized co-ordinates in mechanics. Of the other two, one is particularly simply defined, and the other has commuting co-ordinates. The Poisson brackets can be derived from quite general considerations because the various mass-centres are expressible in terms of integrals of the energy-momentum tensor which are directly connected with the infinitesimal operators of the group of Lorentz transformations. The definitions are readily applicable to a single particle in theories, such as are current for elementary particles, where a co-ordinate observable does not exist, but an energy-momentum tensor does, and furnish the nearest approach possible to such observables. They are applied to electrons, particles of spin 0 and $\hbar$ (scalar- and vector-meson theories), and to photons. A.

530.12 : 531.18

845. On the dynamics of high velocities. KAUFMANN, W. *Nachr. Wiss. Göttingen* (*No.* 1) 26–8 (1946) *In German.*—The Lorentz transformations are derived from the law of conservation of momentum without any reference to electrodynamics. The equivalence of mass and energy is assumed. H. B.

530.14 : 538.3

846. The line mechanics of the electric "field matter" [Feldmaterie]. FLAMM, L. *S.B. Akad. Wiss. Wien*, **155**, *Abt. IIa* (*Nos* 7–8) 221–79 (1947) *In German.*—Fresnel's light theory and Maxwell's electrodynamics attempted to explain physical phenomena on a mechanical basis, but failed due to difficulties with the required properties of the ether. If Newton's point mechanics is replaced by the author's line mechanics the difficulties disappear; atomic physics phenomena are then capable of explanation by a simple mechanical picture. This is impossible with wave and quantum mechanics, which derive mechanics from electrodynamics. The author gives a systematic treatment of the line mechanics of matter in the electric field; including the dynamics of the electric field, the mechanistic basis of Maxwell's equation, calculation of electric and magnetic fields, Hertz function, potentials and the static field. V. W. R.

530.145

847. A remark on the Schrödinger equation in arbitrary coordinates. DRÁGANU, M. *C.R. Acad. Sci., Paris*, **226**, 1802–3 (*May* 31, 1948) *In French.*

530.145

848. Use of projectors in the theory of magnitudes not simultaneously measureable. DE BEAUREGARD, O. C. *Ann. Phys., Paris* (*Sér.* 12) **3**, 376–91 (*May–June*, 1948) *In French.*—The extension of von Neumann's theory of propositions to non-commutative projectors is discussed and application is made to quantum mechanics. The connection with Heisenberg's uncertainty principle is studied and the theory is applied to some problems involving momentum operators. L. S. G.

530.145 : 531.19

849. Quantum statistics and the $\aleph$ theorem. EINBINDER, H. *Phys. Rev.*, **74**, 805–8 (*Oct.* 1, 1948).—The thermodynamic consequences of the state equation $PV = sE$ are investigated. For such a system $E = V^{-s}\phi(TV^s)$, $S = \chi(TV^s)$ and $A = V^{-s}\psi(TV^s)$. During an adiabatic change TV^s, EV^s, and $PV^{1+1/s}$ are constant. The $\aleph$ theorem is derived: A system of mechanically non-interacting particles in equilibrium in a field-free space, which individually obey the laws of non- or completely relativistic quantum mechanics, has $PV = sE$; as $T \to 0$, then $S \to C'$; and it either has a zero-point energy, $E = CV^{-s}$, $(\partial E/\partial V)_T > 0$, or it condenses, $P = CT^{1+1/s}$, $(\partial E/\partial V)_T < 0$. The theorem is used to predict that a strongly degenerate gas obeying intermediate statistics will possess a zero-point energy,

$E = CV^{-\frac{2}{3}}$. Further, it clarifies the statement that the third law is a quantum mechanical law, showing that it is satisfied by such a general system. If $PV = sE$, a necessary condition for it to be obeyed is $(\partial E/\partial V)_T \neq 0$; a statistical attraction or repulsion must be present, i.e. $(\partial E/\partial V)_T$ greater or less than zero, respectively. Finally the $\aleph$ theorem yields an almost intuitive demonstration of the Einstein condensation phenomenon in Bose–Einstein statistics. A.

530.145 : 531.314.5

850. On the relativistic invariance of quantized field theories. DE WET, J. S. *Proc. Roy. Soc. A*, **195,** 365–76 (*Dec.* 22, 1948).—Heisenberg and Pauli (1929) have shown how to quantize field theories derived from Lagrangians containing first-order derivatives of the field quantities. They showed their quantization to be Lorentz invariant. Fuchs (1939) subsequently showed that the quantized theory was in fact invariant under general transformations of co-ordinates. The present author in another paper has shown how the theory of Heisenberg and Pauli can be extended to field equations derived from higher order Lagrangians, i.e. Lagrangians containing higher derivatives than the first of the field quantities. In the present paper the general relativistic invariance of the higher order quantized theories is established, making use of the generalized Poisson brackets introduced by Weiss. A.

530.145 : 535.14

851. Damping theory and the propagation of radiation. HAMILTON, J. *Proc. Phys. Soc., Lond., A*, **62,** 12–18 (*Jan.*, 1949).—It is shown that a careful examination of the concepts involved in radiation damping theory makes it possible to treat the propagation of energy from one atom to another through the electromagnetic field. An exact and continuous solution of the propagation problem is given. [See Abstr. 852 (1949)]. A.

530.145 : 535.14 : 537.1

852. Collision problems and the theory of radiation damping. HAMILTON, J. *Proc. Phys. Soc., Lond., A*, **62,** 2–11 (*Jan.*, 1949).—The relation between radiation damping theory and the problem of the radiationless collision of an electron with a field of force is discussed. It is shown that the divergence difficulties such as appear in the damping treatment of Compton scattering do not arise, and the "cut-off" of damping technique is not necessary. The same result applies to the relativistic collision of two electrons. [See Abstr. 851 (1949)]. A.

530.145 : 538.3

853. Elimination of divergences in the meson theory. I. SCHÖNBERG, M. *Phys. Rev.*, **74,** 748–60 (*Oct.* 1, 1948).—The divergences of the meson theory are avoided by using a method introduced by the author in quantum electrodynamics; the method is worked out for the case of pseudoscalar charged mesons. The quasi-static forces between the nucleons are treated as relativistic actions at a distance; two independent complex pseudoscalars are used in the description of the meson field. It is shown that it is possible to choose separately the type of nuclear forces and the interaction with the meson field, because of the action-at-a-distance treatment. The formalism, associated to special rules of interpretation, leads to finite transition probabilities; it can also be applied to self-energy problems and leads to finite self-energies and magnetic moments. In the computation of the self-energies and magnetic moments two constants appear, which may be chosen in such a way as to give different masses to the proton and neutron. A.

530.145 : 538.3

854. The use of phase space in classical and quantum theory. CORBEN, H. C. *Phys. Rev.*, **74,** 788–94 (*Oct.* 1, 1948).—It is suggested that the symmetry between position and momentum space in classical and quantum mechanics may be extended by closer consideration of the concept of phase space. The discussion is limited to the kinematics of a single particle in phase space, to which is associated a metric which describes both the gravitational and the electromagnetic fields acting on the particle. The formulation is applicable only to a charged particle, and implies that for such a particle in an electromagnetic field the Poisson bracket of two position co-ordinates does not vanish in general, so that in quantum theory these co-ordinates do not commute. A fundamental constant is introduced as the ratio of the natural and Gaussian units of electromagnetic field strengths and, expressing this constant in terms of $\hbar$ and a length l, the theory satisfies a correspondence principle with present theory in the limit $l \to 0$. By postulating that $l \simeq 10^{-13}$ cm, one is led to the basis of a theory which is indistinguishable from present theory for field strengths $\ll (137)^{\frac{1}{2}}el^{-2}$, but which leads to essential modifications for the interaction of charged particles separated by distances of $\sim$ nuclear dimensions. A.

530.145 : 538.3

855. Phenomenological quantum electrodynamics. II. Interaction of the field with charges. JAUCH, J. M. AND WATSON, K. M. *Phys. Rev.*, **74,** 1485–93 (*Nov.* 15, 1948).—The quantization of the phenomenological field is carried through with the presence of charged particles described by a Dirac Hamiltonian. The elimination of the longitudinal field presents some features which are qualitatively different from the vacuum case. In the first place the Coulomb energy has an angular dependent term. Further the elimination procedure introduces an additional term in the interaction Hamiltonian which is proportional to the medium velocity. The physical significance of this term is clarified in the discussion of the Čerenkov radiation, which is carried through in the two co-ordinate systems: medium at rest, particle moving; and particle at rest, medium moving. The result for the total radiation emitted is in agreement with the corresponding classical calculation. A.

530.145.6 : 535.4

856. Theory of scattering processes. FEENBERG, E. *Phys. Rev.*, **74,** 664–9 (*Sept.* 15, 1948).—The formal infinite series for the probability amplitudes are transformed by (i) a regrouping procedure which separates out "repetitive" terms from all orders beyond the second and combines them to produce a common factor multiplying all orders; (ii) a procedure of summation to a closed form (essentially an analytical continuation) replacing the above common factor by a generalized energy denominator; and (iii) unlimited repetition of (i) and (ii). A.

530.145.6 : 537.122 : 538.3

857. On the electrodynamic self-energy of the electron. SALPETER, E. E. *Proc. Roy. Soc. A*, **195**, 163–73 (*Dec.* 7, 1948).—The stationary-state wave equation for an electron at rest in a negative-energy state in interaction with only its own electromagnetic field is considered. Quantum electrodynamics, single-electron theory and a "cut-off" procedure in momentum-space are used. Expressions in the form of expansions in powers of $e^2/\hbar c$ are derived for the wave function ψ and the energy-eigenvalue E by a method which is not based on the assumption that the self-energy is small. The convergence of the expansion for E is not proved rigorously but the first few terms are shown to decrease rapidly. For low cut-off frequencies K_0 the expression for E behaves as the equivalent perturbation expression, but for large K_0 it behaves as $-\sqrt{(e^2/\hbar c)}\hbar K_0$. The variation principle is applied to an approximation (obtained from the expansion method) for ψ, and it is proved rigorously that for large K_0 the self-energy is $< \text{or} = -\sqrt{(e^2/\hbar c)}\hbar K_0$. Hence, if the electron wave-equation is considered as the limiting case of the "cut-off" equation as $K_0 \to \infty$, it is established that the divergences obtained are not merely due to improper use of perturbation theory and that the self-energy is indeed ∞. A.

530.145.6 : 538.3

858. Relativistic cut-off for quantum electrodynamics. FEYNMAN, R. P. *Phys. Rev.*, **74**, 1430–8 (*Nov.* 15, 1948).—A relativistic cut-off of high frequency quanta, similar to that suggested by Bopp, is shown to produce a finite invariant self-energy for a free electron. The electromagnetic line shift for a bound electron comes out as given by Bethe and Weisskopf's wave packet prescription. The scattering of an electron in a potential, without radiation, is discussed. The cross-section remains finite. The problem of polarization of the vacuum is not solved. Otherwise, the results will in general agree essentially with those calculated by the prescription of Schwinger. An alternative cut-off procedure analogous to one proposed by Wataghin, which eliminates high frequency intermediate states, is shown to do the same things but to offer to solve vacuum polarization problems as well. A.

530.145.63 : 538.11

859. The theory of magnetic poles. DIRAC, P. A. M. *Phys. Rev.*, **74**, 817–30 (*Oct.* 1, 1948).—If one supposes that a particle with a single magnetic pole can exist and that it interacts with charged particles, the laws of quantum mechanics lead to the requirement that the electric charges shall be quantized—all charges must be integral multiples of a unit charge e connected with the pole strength g by the formula $eg = \frac{1}{2}\hbar c$. Since electric charges are known to be quantized and no reason for this has yet been proposed apart from the existence of magnetic poles, this is a reason for taking magnetic poles seriously. The fact that they have not yet been observed may be ascribed to the large value of the quantum of pole. In 1931 the author gave a primitive theory which described the motion of a pole in the field of a charged particle whose motion is given, or the motion of a charged particle in the field of a pole whose motion is given. The present paper sets up a general theory of charged particles and poles in interaction through the medium of the electromagnetic field. The idea which makes this generalization possible consists in supposing each pole to be at the end of an unobservable string, which is the line along which the electromagnetic potentials are singular, and introducing dynamical co-ordinates and momenta to describe the motion of the strings. The whole theory then comes out by the application of standard methods. There are unsolved difficulties, concerned with the interaction of a point charge or a point pole with the field it produces itself, such as occur in all dynamical theories of fields and particles in interaction. A.

530.145.63 : 538.3 : 537.12

860. Quantum theory of the point electron. I. SCHÖNBERG, M. *Phys. Rev.*, **74**, 738–47 (*Oct.* 1, 1948).—A new treatment of the quantum theory of the electromagnetic field is discussed. The interactions between the particles and their interactions with the radiation field are treated according to the ideas of the author's classical theory. The radiation field is taken as a difference of two fields analogous to the field of the Heisenberg–Pauli electrodynamics. The commutation rules for the radiation field differ essentially from those of the Heisenberg–Pauli electrodynamics. In our formalism it is possible to avoid all the divergences by a suitable choice of the wave function of the system particles plus field. The physically relevant wave functions satisfy wave equations similar to those of systems with finite numbers of degrees of freedom, although they are also exact solutions of the Schrödinger equation of the system "particles plus field" which has an infinite number of degrees of freedom. There is also the possibility of getting finite non-vanishing self-energies. A.

530.145.63 : 538.3 : 537.122

861. The meson field and equations of motion of point particles. MAJUMDAR, R. C. AND APTE, A. S. *Phys. Rev.*, **74**, 538–47 (*Sept.* 1, 1948).—The equation of motion of a point particle possessing a charge and interacting with a meson field (both vector and scalar) is derived from a generalization of the scheme of Infeld and Wallace for determining the equation of a point electron in an electromagnetic field. The retarded and advanced meson fields of the point particle and the nature of the simultaneous expressions for the symmetric, $\frac{1}{2}$(ret. + adv.), and radiation, $\frac{1}{2}$(ret. − adv.), potentials and field intensities are investigated. The simultaneous radiation field is found to be always finite for $r \to 0$, whereas the corresponding symmetric field allows expansion in powers of r with -2 as the lowest, r being the radius of the 3-dimensional sphere surrounding the singularity which represents the point particle. It is shown that the removal of the singularities from the symmetric field leads to the equation of motion given by Bhabha for the vector meson field in the case of the retarded field: the symmetric field, on the other hand, leads to the equation of motion in which the radiation damping is absent. The corresponding equation of motion of a point particle in a scalar meson field is also given. A.

530.145.63 : 539.152.1

862. Normalization of the deuteron wave function. SMORODINSKI, Y. *Dokl. Akad. Nauk, SSSR*, **60**

(*No.* 2) 217–18 (1948) *In Russian.*—The wave function of the deuteron, introduced by Bethe and Peierls and generally used, viz. $\psi_a \sim 1/r\varepsilon^{-\alpha r}$ is only an approximation. It is usually normalized on the model of the deuteron with interaction represented by a rectangular well, which is very illogical, as the most valuable feature of deuteron theory is usually seen in its independence on a concrete form of the interaction potential. The author has already shown [*J. Exp. Theor. Phys.*, **15**, 89 (1945); **17**, 941 (1947)] that this inconsistency can easily be removed by a more exact theory. In the evaluation of the integral required in the normalization of the wave function there are difficulties owing to the exponential character of that function, as the region of discontinuity around the origin causes the greatest deviations between the approximate and the exact wave function. This difficulty is overcome by introduction of more exact boundary conditions with empirical coefficients. This is carried out, the result being that the normalized function takes the form

$$1{\cdot}23\sqrt{(2\alpha)}\varepsilon^{-\alpha r} \simeq \sqrt{(3\alpha)}\varepsilon^{-\alpha r}.$$ B. F. K.

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.19

863. A general method for the study of statistical systems in a steady state. Weinreb, E. A. and Spivak, G. V. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 3) 463–6 (1948) *In Russian.*—The function f giving the velocity distribution in a statistical system is deduced from the H-function of Boltzmann, and from mathematical relations linking f with the momentum of the system, the flow of this momentum, and other physical data. The introduction of the momentum enables the authors to take into account the rotational effects produced by mechanical, magnetic or electric forces. The method is valid in the very general case when any arbitrary forces are applied to the system. F. B.

531.36/.38

864. On the general heavy sphere. Hamel, G. *Z. angew. Math. Mech.*, **25/27**, 159–60 (*Aug.–Sept.*, 1948) *In German.*—A heavy rigid sphere moves about a fixed point which is not its centre of gravity. The author is concerned with the validity or otherwise of certain integrals of the motion due to Schiff and Stückel [*Math. Ann.*, **65** (1908)]. G. C. McV.

531.382

865. Speed control for the air driven ultracentrifuge. Majumdar, S. D. and Sarkar, G. N. *Rev. Sci. Instrum.*, **19**, 541–4 (*Sept.*, 1948).

531.382

866. A technique for high rotational speeds. Marshall, D. G. *J. Sci. Instrum. Phys. Ind.*, **25**, 348–51 (*Oct.*, 1948).—A description is given of the design and construction of steel rotors that can be spun in vacuum to peripheral speeds exceeding 10^5 cm/sec. The rotors are tapered rods, several inches long, and are driven by a rotating magnetic field. Orbital motions are prevented by means of a magnetic suspension to which oil-damping is applied. A.

531.51 : 550.31

The discontinuities of the 2nd derivatives of th gravity potential. *See Abstr.* 1250

MECHANICAL MEASUREMENTS 531.7

531.724 : 533.6.011 : 539.215.

Determination of dust particle size by air resistanc measurement. *See Abstr.* 1181

531.74 : 535.83.

867. Mirror readings by autocollimation. Freise, H *Arch. tech. Messen, Issue* 155 (*Ref.* J1112–1) T7 (*June*, 1948) *In German.*—Description of an auto collimating telescope arranged to read angular dis placements of mirrors. H. H. HOP

531.76 : 621.317.3

868. The measurement of very short time interval between two sparks. Bull, L. *C.R. Acad. Sci., Paris* **226**, 1353–4 (*April* 26, 1948) *In French.*—In connectio with the photography of shock waves it is necessar to know exactly the time interval between 2 sparks A set-up is described for this purpose employing rapidly turning mirror in conjunction with a cathod ray tube. Time intervals down to 2 μsec can b evaluated. A. H

531.783 : 531.4 : 621.317.7.085.2

869. Apparatus for measuring the static frictiona torques of instrument jewels. Pearse, W. H. *J. Sci Instrum. Phys. Ind.*, **25**, 344–6 (*Oct.*, 1948).—A apparatus is described which can be used to obtain measure of the surface quality of synthetic sapphir "V" jewels and hence enable their performance a jewel bearings for precision indicating instruments t be expressed quantitatively. A pivoted element rest on the jewel to be examined and is deflected by an ai jet. The air flow is gradually reduced and the elemen allowed to return to a position of equilibrium with n air flowing when the static frictional couple betwee jewel and pivot is just balanced by the restoring torqu of a control spring. Tests with the apparatus using a pivot tip radius of 0·003 in and element weigh 4·3 g have given torque values ranging from 0·092 dyne-cm for a jewel with unresolved surfac roughness at ×225 magn. to 0·85 dyne-cm for a jewel with visible surface irregularities at ×5 magn. A

531.787.4 : 532.111 : 532.6

870. A simple method for measuring surface pres sures—use of a floating plate. Dickinson, W. and Iball, J. *J. Sci. Instrum. Phys. Ind.*, **25**, 362 (*Oct.* 1948).—Instead of using a balance, as in the ordinary Wilhelmy plate method of measuring surface pressures a buoyancy chamber is attached to the plate, and changes in surface tension (surface pressures) are measured by recording the change in height of the floating plate. A

531.787.9 : 578 : 621.317.3

871. A device for measuring physiologic pressure phenomena using the bonded electrical wire resistance strain gauge. Bierman, H. R. *Rev. Sci. Instrum.* **19**, 707–10 (*Oct.*, 1948).—The gauge is bonded

securely to a metal diaphragm, deformation of which changes the resistance of the gauge, and causes a flow of current through an appropriate circuit. Examples of the applications in physiology of this device are presented, with typical recordings. A.

MECHANICS OF FLUIDS 532

532.123 : 539.42 : 536.423.15 : 532.782

872. The fracture of liquids. FISHER, J. C. *J. Appl. Phys.*, **19**, 1062–7 (*Nov.*, 1948).—A liquid subjected to negative pressure is metastable; vapour bubbles form spontaneously and grow until the pressure of the system rises to the equilibrium vapour pressure. The rate of bubble formation is calculated from the theory of nucleation, and the negative pressure p_t that gives one bubble (i.e. fracture) in t seconds is determined. p_t is very nearly independent of t, and is proportional to σ^3 where σ is the surface tension. Subcooled liquids such as glass also are metastable under negative pressure; cracks form spontaneously and grow until the pressure rises to the equilibrium vapour pressure. Nucleation theory leads to an expression for the fracture stress of glass that is proportional to $(E^2\sigma^3)^{\frac{1}{4}}$ where E is the elastic modulus. The transition from high temperature cavity-nucleated fracture to low temperature crack-nucleated fracture is examined. Fracture strengths calculated from nucleation theory agree satisfactorily with the maximum experimental values, and are an order of magnitude smaller than the forces required for simultaneous separation of all atomic bonds cut by a plane surface. The frequent occurrence of premature failure is associated with the presence of pre-existing surface cracks in glass, and of positive contact-angle impurity in contact with liquids. A.

532.13 : 536.5

873. Determination of the viscosity of glycerine and various softening agents within a temperature range of +60 and −50°C. MEISSNER, W. *Z. angew. Phys.*, **1**, 75–8 (*March*, 1948) *In German.*—The viscosity η of glycerine is determined by a method based on Poiseuille's formula. The liquid is moved to and fro by pistons through a Cu tube, internal diameter 5 mm. A null method is used to measure the pressure difference at two points far enough from the ends of the tube for the formula to be applicable. The accuracy of the results is 2·2%. The temperature is measured to within 0·1°C with three manganin-constantan thermocouples. For temperatures T greater than 303°K, this equation holds: $\log_{10}\eta = 3\,168/T - 9{\cdot}657$. For glycerine of sp. gr. 1·26 $\eta = 0{\cdot}72$ poise at 60°C. A modification of Maxwell's oscillating disc method is used for 19 other organic substances, the instrument being calibrated in terms of the viscosities of glycerine, water, and their mixtures. Tables and graphs present the results, whose maximum error is 5·2%. Diagrams are given for both instruments. R. A. W.

532.13 : 539.215.4

874. Magnitude and character of errors produced by shape factors in Stokes' law estimates of particle radius. KUNKEL, W. B. *J. Appl. Phys.*, **19**, 1056–8 (*Nov.*, 1948).—In order to estimate the possible errors introduced by deviations from the spherical particle shape in Stokes' law estimates of dust particle sizes, a model study was made with objects of various shapes falling in oil of high viscosity. It was found that all shapes fall more slowly than the sphere of the same mass and volume. The true size and mass will, therefore, always $>$ the estimates calculated from their rate of fall by means of Stokes' law. For shapes of extreme dimensions (very thin plates and needles) the error thus introduced exceeded 50%. For more common configurations of spheres it was ~20% or less. No simple relation between particle surface or any other parameter and the rate of fall could be discovered. All plates and needles turned their planes and longer axes into a horizontal direction when falling freely, unless one side was distinctly weighted. A small asymmetry in weight distribution tilts the planes slightly, causing the model to drift sideways in its fall. In a Hopper and Laby method of particle analysis such a drift makes a particle appear charged, although it may be neutral. It is, therefore, not possible to analyse platelike and needlelike powder and dust particles by such a method. A.

532.14 : 536.71

875. Calculation of liquid densities at elevated temperatures. HANSON, E. S. *Industr. Engng Chem.*, **41**, 96–9 (*Jan.*, 1949).—A procedure has been developed for calculating the densities of liquids, other than paraffin hydrocarbons, at temps. from the normal boiling point to near the critical temp., based on the principle of corresponding states. The only data required for the calculation are the critical temp. of the substance and its liquid density at any temp. $>$ ½ the reduced temp. A.

532.5

876. Relation between plane and axial-symmetric boundary layers in compressible liquids. MANGLER, W. *Z. angew. Math. Mech.*, **28**, 97–103 (*April*, 1948) *In German.*—The problem of the velocity, temperature and density distribution in the boundary layer of a solid of revolution is transformed into a corresponding 2-dimensional case and solved. The method is applied to calculate the boundary layer of a circular cone in a supersonic flow zone, and of a large tank with a small central hole at the bottom. V. W. R.

532.51

877. Laminar flow of Newtonian and Maxwellian liquids. FROMM, H. *Z. angew. Math. Mech.*, **28**, 43–54 (*Feb.*, 1948) *In German.*—In Maxwellian liquids the rotation of an element in a space of constant stress results in elastic deformation. The flow is investigated by the use of tensors, taking both rotation and translation into account. With stationary laminar flow the shear stress $<$ ½ numerical value of the modulus of shear. The flow of these liquids through pipes or plates may give rise to stable and unstable regions of velocity distribution with discontinuous pressure distribution. Pressure measurements in Maxwell liquids should be carried out by Pitot tubes with 4 transverse perforations. The similarities between Maxwell liquids and macromolecular colloidal "structure-viscous" solutions are discussed. V. W. R.

532.513

878. A note on the inclination sensitiveness of the Prandtl tube in the measurement of statical pressures. KANOLD, H. J. *Z. angew. Math. Mech.*, **25/27**, 124–6 (*July*, 1947) *In German.*—A current of given velocity is applied to a Prandtl tube in a direction inclined to its axis at an angle α. The theoretical formula representing the pressure difference to be measured in terms of velocity data is investigated for 3 distinct forms of aperture in the pressure measuring ring, the aperture being: (1) a complete ring, (2) a half ring, (3) a regular system of small holes with centres on a circular section of the tube. In each case the result arrived at is the same, and accordingly the difference observed should be independent of the direction of the transverse component of the current applied to the tube. Values of the pressure difference term obtained by measurement and by calculation are given for increasing values of α. They are in agreement for $\alpha < 20°$; an explanation of the cause of the discrepancy at the higher values is suggested. G. G.

532.517.2 : 532.54

879. Note on stability of laminar viscous flow between parallel planes. MEKSYN, D. *Proc. Roy. Soc. A*, **195**, 174–9 (*Dec.* 7, 1948).—The problem of the stability of laminar flow in two dimensions was first discussed by Heisenberg [see Abstr. 2902 (1924)]. Its solution involves the integration of a fourth order differential equation containing a large parameter, and comprising two slowly-varying and two rapidly-varying integrals. Amongst others, Tollmien has discussed the problem [*Z. angew. Math. Mech.*, **25/27**, 34, 70 (1947)]. Meksyn has given a rigorous solution of the problem and deduced a transformation of the slowly varying integrals which, at first sight, appears to be quite different from the results of Heisenberg and Tollmien [*Proc. Lond. Math. Soc.*, **49**, 436 (1947)]. Here this transformation is presented in a new form, and it is shown that the author's previous conclusion that Tollmien's result was invalid so far as the hydrodynamical problem is concerned, cannot be sustained; the terms neglected by Tollmien in his analysis are without effect on the final result. J. S. G. T.

532.517.4

880. Studies on turbulence. MORETTI, G. *Ric. Sci. Ricostruz.*, **17**, 1623–5 (*Nov.*, 1947) *In Italian.*—Reports results of papers published elsewhere and based on the method developed by Taylor and Karman. The investigation is confined to the problem of the 2-dimensional turbulent transport and it therefore is possible to contract the 3 Navier–Stokes equations into a single one, containing one term characterizing turbulence. This term may be represented as the product of two orthogonal components of the turbulent oscillation, or of their r.m.s. values $\times$ a correlation factor. It is shown that this factor $\propto$ mean velocity gradient, so that the turbulence term as such can be expanded into a series in terms of the velocity gradient and its derivatives. This makes Navier–Stokes' equation formally integrable, the integration constants being then determined from experimental data on the usual considerations of affinity. It is claimed that this simplified method furnishes a result incorporating the common features of all the divergent theories (Prandtl, Taylor, Karman, etc.), and also, that the representation of experimental data so obtained is better than that of any previous theory.

532.526 : 533.6.011

881. Integration of the boundary-layer equations for a plane in a compressible fluid. MEKSYN, D. *Proc. Roy. Soc. A*, **195**, 180–8 (*Dec.* 7, 1948).—Analytical integration of Emmons and Brainerd's equations for arbitrary values of the Prandtl number and the Mach number, using the powerful asymptotic method of integration developed by the author in a previous paper [Abstr. 879 (1949)]. In the first approximations the asymptotic integration gives ample accuracy and can be determined by simple and elementary methods. The results of this comparatively rapid calculation are in very satisfactory agreement with the results of the lengthy numerical calculations made by Emmons and Brainerd for certain specific values of Prandtl number and Mach number. A.

532.582

882. Drag coefficients of steel spheres entering water vertically. MAY, A. AND WOODHULL, J. C. *J. Appl. Phys.*, **19**, 1109–21 (*Dec.*, 1948).—Drag coefficients have been determined from high-speed motion pictures for $\frac{1}{4}$ in to $1\frac{1}{2}$ in steel spheres shot into water vertically with speeds from 25 to 208 ft/sec. These drag coefficients correspond to the entrance cavity phase and to the v^2-law drag forces only, the immediate effects on the spheres of other forces being eliminated in the calculations. It is found that C_D is a function of both the Reynolds and Froude numbers. Within the range investigated, the dependence may be expressed by $C_D = 0{\cdot}0174 \ln(RF^{\frac{1}{2}})$. A.

CAPILLARITY 532.6

532.61 : 532.59

883. The damping of capillary waves as a function of the surface tension. MERLE, M. *C.R. Acad. Sci., Paris*, **226**, 1504–6 (*May* 10, 1948) *In French.*—To overcome the rapid decrement of circular capillary waves in water the latter is made to flow very slowly. The flow gives rise to the continuous production of a fresh surface. Photographs show the increase of the resultant ripple-field, and the effect of surface tension on damping. R. A. W.

532.62 : 532.111 : 531.787.4

Method for measuring surface pressures. *See Abstr.* 870

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

884. Constitution of water. EUCKEN, A. *Nachr. Wiss. Göttingen* (*No.* 1) 36–48 (1946) *In German.*—Physical properties of H_2O are considered and an attempt is made to deduce a structure for H_2O which, with the fewest assumptions, will agree satisfactorily with these properties. Considerations of sp. heat show that chain association does not lead to satisfactory agreement, but the fraction of the mol. heat

arising from dissociation at 0° could be explained if H_2O consisted at this temp. of relatively few simple molecules together with $(H_2O)_2$, $(H_2O)_4$ and $(H_2O)_8$ in approx. equal amounts. In order to obtain agreement the corresponding heats of dissociation to simple molecules must be 2 350, 2 750 and 3 200 g.-cal per g.-mol. The explanation of anomalies in the effect of temp. and pressure on the vol. of H_2O in terms of mol. complexity is considered, $(H_2O)_8$ being assumed to have an ice-like structure. This structure is in good agreement with Bridgman's results on the variation of the η of H_2O with pressure. The Eötvös rule, the Pictet–Trouton rule, the crit. coeff. and the X-ray scattering diagram of H_2O are also considered. The effect of dissolution of an electrolyte on the composition of the H_2O is considered. If, say, KCl is dissolved in H_2O, the K^+ and Cl' ions combine with a relatively large number of H_2O molecules, thus disturbing the equilibrium in the H_2O. Assuming that each of the ions takes up 8 H_2O molecules, the mol. fraction of $(H_2O)_8$ in a N. solution decreases from 0·30 to 0·263. This corresponds to the effect of a pressure of 300 atm. on pure H_2O. B. A.

532.7 : 531.13 : 536.22

885. The steady non-uniform state for a liquid. EISENSCHITZ, R. *Proc. Phys. Soc., Lond., A*, **62**, 41–9 (*Jan.*, 1949).—The Smoluchowski equation for the distribution of the relative co-ordinates of a representative pair of molecules in a liquid is formulated in such a way that the effect of non-uniform velocity or temperature is taken into account. The equation is reduced to an ordinary linear differential equation of the second order. One of the two constants of integration is readily determined, whereas the determination of the other may lead to inconsistencies. The molecules are assumed to interact with the average potential that is appropriate to thermal equilibrium. If it is assumed that this potential becomes infinite of the first order at distance zero then the problem of viscous flow and the problem of thermal conduction are uniquely soluble. Approximate evaluation of the transport coefficients shows the right kind of temperature effect. The result is in accordance with the previous treatment by means of the cell model. A.

532.7 : 536.423

886. The theoretical treatment of the evaporation process. PRÜGER, W. *S.B. Akad. Wiss. Wien.*, **149**, *Abt. IIa* (*Nos* 1–2) 31–58 (1940) *In German.*—Investigates the magnitude of the condensation and evaporation coeff. by considering the molecular energy and matter balance at the liquid/vapour boundary, and by developing kinetic vapour emission formulae. The condensation-coeff. of solid and liquid bodies may be < 1 even with highest surface purity. The question whether the vapour of a pure boiling liquid raises the liquid surface above boiling temp. can be solved only by use of hypothetical assumptions about the liquid structure. If the cohesion forces of the liquid are independent of molecule velocity the vapour must leave with liquid surface temp. In general, the temp. of the evaporating vapour lies between the boiling and the surface temp. of the liquid, depending on its nature. V. W. R.

532.71 : 542.48 : 536.712

887. The mechanism of isothermal distillation in the porous-disk osmometer. WILLIAMSON, A. T. *Proc. Roy. Soc. A*, **195**, 97–115 (*Nov.* 12, 1948).—Theoretical investigations to clarify several well-established but unexplained observations by previous workers experimenting on the unusual osmotic-pressure technique known as isothermal distillation. The treatment is essentially thermodynamic, and leads to the derivation of equations which agree with the experimental evidence while showing how substantial improvements in performance can be achieved by designing the apparatus in accordance with the theory. One of the derived equations stresses the importance of good thermal conduction between the solvent and solution inside the stillhead, while another gives a quantitative relationship between thermostat temperature fluctuations and osmotic-pressure errors. A description is then given of the essential features of the experimental apparatus developed for the measurement of the molecular weights of high polymers. A.

532.72

888. Measurement by radioactive tracers of diffusion in liquids. GEMANT, A. *J. Appl. Phys.*, **19**, 1160–4 (*Dec.*, 1948).—A method is described. Results for uranyl nitrate solutions, revealing the diffusion of Th^{234}, in water and dioxane are presented. A.

532.73–3 : 541.123.2

889. On critical phenomena of saturated solutions in binary systems. DIEPEN, G. A. M. AND SCHEFFER, F. E. C. *J. Amer. Chem. Soc.*, **70**, 4081–5 (*Dec.*, 1948).—Phase-rule studies in the neighbourhood of the critical point for ethylene have been carried out for several binary systems composed of ethylene and organic materials with low vapour pressures and melting points well above the critical temperature of ethylene. The types of phase equilibria observed have been discussed and classified. Data for a number of the systems studied indicate a substantial solubility of the solid component in fluid ethylene above its critical temperature. Of these the system ethylene–naphthalene has been selected for a more extensive study of the supercritical solubility phenomenon. A.

532.73–3 : 541.123.2

890. The solubility of naphthalene in supercritical ethylene. DIEPEN, G. A. M. AND SCHEFFER, F. E. C. *J. Amer. Chem. Soc.*, **70**, 4085–9 (*Dec.*, 1948).—An apparatus for the preparation and precise measurement of saturation concentrations of slightly volatile solids in fluids at temperatures above their critical points has been devised. The apparatus has been used to determine the saturation concentrations of naphthalene in ethylene at 12, 25 and 35° and at various pressures. The concentrations found are as much as 25 000 times as great as those predicted from the vapour pressure of naphthalene and indicate a specific solubility effect. Important characteristic features of the phase-rule diagrams for the ethylene–naphthalene system in the vicinity of the critical point for ethylene have been described and discussed. A.

532.782 : 536.653

Thermodynamic properties of NaCl–NaBr solid solutions. *See Abstr.* 996

MECHANICS OF GASES 533

533.15

891. Determination of the coefficients of diffusion into air of cyclohexane, acetone and chloroform. GORYUNOVA, N. A. AND KUVSHINSKI, E. V. *J. Tech. Phys., USSR*, **18** (*No.* 11) 1421–5 (1948) *In Russian.*—The measurements were made on Stefan's second method. [*Ann. Phys. Chem.*, **41**, 725 (1890)]. The following precautions were taken: (1) For suppressing convection, (*a*) density of the vapours of the liquid kept > density of the air; (*b*) temperature and pressure kept constant during test; (*c*) uniform temperature in all parts of the apparatus. Low rate of evaporation so as to keep the lowering of temperature at the meniscus of the liquid negligible. This also ensures condition (*c*) to be satisfied. (2) The tube was so long that the hydrodynamic flow of the gas mixture could be characterized by the mean flow velocity. (3) The vapour concentration was zero at the open end of the vessel. In these conditions, the coefficient of diffusion can be computed from the weight loss of the evaporating liquid by means of a well-known formula. The results are as follows: Cyclohexane (at 45°C; 767–755·0 mm Hg) mean value 0·086 ± 0·003 cm²/sec; chloroform (at 0°C; 777–770 mm Hg) (m.v.) 0·091 ± 0·002 cm²/sec; acetone (at 0°C; 771–755 mm Hg) (m.v.) 0·109 ± 0·009 cm²/sec. B. F. K.

533.15 : 533.7

892. Empirical relations between vapour diffusion coefficients in various gases. KUVSHINSKI, E. V. *J. Tech. Phys., USSR*, **18**, 909–14 (*July*, 1948) *In Russian.*—A linear relation is shown to exist between the diffusion coefficients of vapours in various gases. The addition theorem of the kinetic radii is corroborated. A.

533.16 : 536.23 : 533.15

893. Viscosity and thermal conductivity of air and diffusivity of water vapour in air. MONTGOMERY, R. B. *J. Met.*, **4**, 193–6 (*Dec.*, 1947).—Carefully chosen numerical values for the viscosity and thermal conductivity of air and diffusivity of water vapour in air are tabulated for temperatures from −20°C to +40°C and for a pressure of 1 000 mb. A summary of physical constants relating to air is included. A.

533.56 : 531.788

894. Diffusion pump pressure gauge. FAIRBROTHER, J. A. V. *J. Sci. Instrum. Phys. Ind.*, **25**, 347–8 (*Oct.*, 1948).—A pressure gauge is described suitable for giving a continuous record of residual pressure in an exhausted vessel such as a cyclotron or Hg-arc rectifier. It consists of a diffusion pump discharging back to the fine-pressure side through a throttle, the amplified fine-side pressure being read off on an oil- or bellows-type manometer connected across the throttle. The sensitivity of the gauge compares favourably with that of the McLeod. A.

533.6.011

895. Calculation of gas flow in the transonic region. BETZ, A. *Z. angew. Math. Mech.*, **25/27**, 150–1 (*Aug.–Sept.*, 1947) *In German.*—The relations used for calculating flow in this region must not change their character when passing through the speed of sound (e.g. elliptic functions at subsonic and hyperbolic functions at supersonic speed). A suitable mathematical relation is obtained from the fact that with non-parallel adjacent streamlines the product velocity × density changes in the direction of the streamlines, while with curved streamlines there is a pressure gradient across the direction of flow. Using this relation the method of calculating gas flow in the transonic region is explained and an application given. V. W. R.

533.6.011 : 532.525 : 534.222.2

896. A contribution to the theory of waves in free gas jets. KAI, F. *Z. angew. Math. Mech.*, **28**, 80–5 (*March*, 1948) *In German.*—Regular symmetric waves were thought to occur when a gas issues from an orifice with supersonic speed. The author finds that similar Mach waves converge in the interior of the jet and form an envelope representing the boundary of adiabatic potential flow. Beyond this the potential flow collapses and a skew compression shock wave is caused. This makes regular symmetric waves an impossibility. V. W. R.

533.6.011 : 534.222.2 : 532.525

897. Disturbances in plane and axial-symmetric sonic and supersonic parallel jets. GUDERLEY, G. *Z. angew. Math. Mech.*, **25/27**, 190–5 (*Oct.*, 1947) *In German.*—Disturbances in supersonic jets propagate themselves along the Mach wave. The nature of propagation is investigated for plane parallel and axial-symmetric jets. The transition of compression waves to shock waves is discussed. Disturbances can propagate themselves along jets of sound velocity either by a parallel supersonic wave or a parallel subsonic wave. V. W. R.

533.6.011.3

898. Influence of slight waviness of the bounding wall on the laminar boundary layer. GÖRTLER, H. *Z. angew. Math. Mech.*, **25/27**, 233–44 (*Nov.–Dec.*, 1947); **28**, 13–22 (*Jan.*, 1948) *In German.*—Fluid flow experiments show that even slight waviness of the bounding wall contour exerts considerable effect on the nature of the boundary layer, and may lead to its "peeling off." The mathematical theory of this effect is developed and yields a picture of the fluid flow near the wall for the case where the undulation wavelength is small compared with the wall length considered. Close to the wall the waviness exerts considerable influence which rapidly decreases towards the outer edge of the boundary layer streamlines. At first the boundary layer "peels off" and readheres, the enclosed space being filled with practically stationary fluid. If a sufficient number of wall waves is encountered the boundary layer peels off altogether. V. W. R.

533.6.07 : 533.6.013.22

899. Calculation of the field of velocities in a cylindrical, supersonic blast pipe, based upon photographs of Mach lines, and method of correcting the profile of the pipe. CARRIÈRE, P. *C.R. Acad. Sci., Paris*, **226**, 1884–6 (*June* 7, 1948) *In French.*—As a desirable alternative to the method of ascertaining the velocity-field characterizing supersonic fluid-flow in a cylindrical channel, by means of Foucault's optical method of photographing the Mach lines and measuring the angles between the lines, the author

shows how the Lagrangian equation of motion, as derived by Ritz, used in conjunction with the Prandtl–Busemann theory of supersonic flow, can be applied for the same purpose. The latter theory can be utilized for the purpose of correcting the profile of the channel so that a uniform axial velocity is produced.

J. S. G. T.

533.691 : 534.22 : 534.321.9

900. A physical theory of supersonic aerofoils in unsteady flow. STRANG, W. J. *Proc. Roy. Soc. A*, **195**, 245–64 (*Dec.* 7, 1948).—Solutions for point and line sources are given, for the "transient" case only, in both stationary and moving co-ordinate systems. These are then integrated to give the solutions for a supersonic aerofoil (*a*) entering a sharp-edged gust, (*b*) following a sudden change of incidence The method of obtaining oscillatory (flutter) solutions from (*b*) comes next, and it is shown that these solutions check with those of Temple and Jahn [R.A.E. Rep. No. SME 3314 (1945)] and hence with others. The failure of Collar's simplified theory [R.A.E. Rep. No. SME 3278 (1944)] is also explained. Finally, the results of some calculations on the entry of supersonic aircraft into gusts are given. These results are in non-dimensional form and cover a fairly wide range of speeds, wing loadings and gust profiles. A.

MOLECULAR THEORY OF GASES 533.7

533.75 : 536.71

901. An equation of state taking account of the critical coefficient. KÄMMERER, C. *Z. angew. Math. Mech.*, **25/27**, 127–8 (*July*, 1947) *In German.*—From the equation of state for any substance in the form $\left(p + \frac{a}{v^2}\right) = \left(\frac{RT}{v} + \frac{b}{v^n}\right)$ the "reduced equation of state" is obtained by introducing the ratios p_x, v_x, T_x defined by $p_x = p/p_e$, etc., where p_e, v_e, T_e, are the critical constants. The "reduced" equation contains the variables p_x, v_x, T_x, and the critical coefficient or constant for each substance defined by $k = RT_e/p_e v_e$. Values of k are given for several gases, and their "reduced equations" formed. The slope of the vapour pressure curve at the critical point on the p_x, T_x, diagram is also expressed in terms of k, and calculated values are compared with experimental values for several gases. G. G.

VIBRATIONS . ACOUSTICS 534

534.01

902. Deduction by a variational method of the dynamical equations of elastic media. CASTOLDI, L. *Nuovo Cim.*, **5**, 140–9 (*June*, 1948) *In Italian.*—Hamilton's principle is applied to derive the equations of motion for a 3-dimensional elastic continuum, in the case of finite deformations. L. P.

534.121.2 : 621.396.611.4 : 621.392.26

903. The analogies between the vibrations of elastic membranes and the electromagnetic fields in guides and cavities. CHERRY, E. C. *Instn Elect. Engrs, Paper* 734 (*Dec.*, 1948) **13** *pp.*—Abstr. 526 B (1949).

534.2

904. Waves in compressible media. WEIBULL, W. *Acta Polytech.* (*No.* 26) [(*Phys. Appl. Math.*) **1** (*No.* 5)] (1948). *K. Tekn. Högsk. Handl.* (*No.* 18) (1948) 37 *pp. In English.*—The basic equations requiring conservation of mass, of momentum and of energy, the equations of state for various media and the formulae for normal shock waves are formulated. Two quantities, $P = a + v$ and $Q = a - v$, where a is a function of the pressure only and v is the particle velocity, are introduced. Their general properties, including the boundary conditions, are deduced. The change of the waveform, the superposition and the reflection of plane continuous waves of finite amplitude are investigated. A.

534.21 : 534.23

905. The origin of sound absorption in water and in sea water. LIEBERMANN, L. N. *J. Acoust. Soc. Amer.*, **20**, 868–73 (*Nov.*, 1948).—The absorption of sound in water and in sea water has been measured in the frequency range 120 kc/s to 1 000 kc/s. The fresh water values were obtained in a lake; the sea water values in the ocean. The fresh water absorption values when extrapolated as (frequency)^2 are in agreement with previous values measured in the laboratory at considerably higher frequencies. It is shown that the observed absorption of water has its origin in viscous dissipation; the calculated values for the absorption agree with the observed if recently measured values for the dilatational viscosity as well as the shear viscosity are included in the calculation. The absorption processes in sea water are different. At frequencies below 100 kc/s the absorption is about 100 times greater than in pure water. Above 1 Mc/s the absorptions are similar. It is shown that this behaviour can be accounted for by introducing a relaxation mechanism with a relaxation time of 10^{-6} sec. The nature of the relaxation mechanism is not known for certain. The proposal is made that it involves the ionic dissociation of sodium chloride in solution. Calculations are made to show that this process is a possibility. A.

534.213

906. Dispersion of compressional waves in isotropic rods of rectangular cross section. MORSE, R. W. *J. Acoust. Soc. Amer.*, **20**, 833–8 (*Nov.*, 1948).—The compressional wave velocity in rectangular brass rods is measured as a function of frequency by means of standing wave patterns made visible by the use of lycopodium powder. An x-cut quartz crystal is used as a driver between frequencies of 200 and 650 kc/s. Results are obtained on rods of different width-to-thickness ratios, the thickness being the same in each case. The dispersion curves are made up of two branches with a discontinuity occurring in one of them when the $\frac{1}{2}$-wavelength is close to the larger dimension. Each of these branches is shown to be determined by one of the lateral dimensions and a qualitative interpretation is offered in terms of a lateral resonant effect. In the case of a square rod the

two branches coincide, and the dispersion is the same as that encountered in a circular rod of the same cross-sectional area. Theoretical calculations are made for the case in which the width is $\geqslant$ the thickness. Numerical solutions are found for the dispersion curves of the first symmetrical mode for different values of Poisson's ratio. Calculated values are in good agreement with measured values when the cross-sectional dimensions are in the ratio of 8 : 1 and the wavelength is smaller than the larger dimension. A.

534.22 : 534.321.9

907. Ultrasonic dispersion in organic liquids. SCHALLAMACH, A. *Proc. Phys. Soc., Lond. B*, **62**, 70–6 (*Jan.*, 1949).—The sound velocities v have been measured, at frequencies f between about 700 and 3 000 kc/s, and at temperatures between about +15° and −80°c, in the following liquids: geraniol, dihydrocitronellyl ether, castor oil and iso-butyl alcohol. There is evidence of a positive dispersion ($\partial v/\partial f > 0$) in the first three liquids at low temperatures. A negative dispersion has been observed in geraniol and di-dihydrocitronellyl ether at higher temperatures, and in iso-butyl alcohol over the whole temperature range. The positive dispersions are discussed on the basis of the classical hydrodynamic theory, and the implications of a complex viscosity are examined. A.

534.222 : 534.321.9 : 534.26

908. The scattering of ultrasonic waves in water by cylindrical obstacles. BAUER, L., TAMARKIN, P. AND LINDSAY, R. B. *J. Acoust. Soc. Amer.*, **20**, 858–68 (*Nov.*, 1948).—An ultrasonic beam produced in H_2O by an oscillating quartz crystal (frequency, 1 145 kc/s wavelength, 1·3 mm) is scattered by cylindrical obstacles. Three different obstacles are used: (*a*) $\frac{1}{4}$ in steel rod, (*b*) $\frac{1}{2}$ in steel rod, and (*c*) $\frac{1}{8}$ in hollow polystyrene tube. Lateral pressure amplitude distribution curves are obtained at different points along the axis of the beam for various positions of the obstacles on the axis. The effect of lateral displacements of the obstacles is studied. Wave-front determinations are made with and without obstacles. The conclusion is reached that transmission through and reflection by the obstacles play an insignificant role compared with diffraction around them. A.

534.222.2

909. The decay of shock waves. CASSEN, B. AND STANTON, J. *J. Appl. Phys.*, **19**, 803–7 (*Sept.*, 1948).—The instantaneous rate of decay or intensification of a shock front in any fluid for which dissipative effects are localized in a shock zone is shown to be directly related to the coexisting pressure gradient in the wake of the wave adjacent to the front. The higher time derivatives of the shock velocity are also explicitly related, although in a more complicated fashion, to the higher spatial derivatives of wake pressure. Thus the experimental observation of the velocity or some related variable of a blast or ballistic shock wave can be used to ascertain properties of the fluid motion in the wake of the shock. Conversely, a knowledge of the wake profile at any instant can be employed to determine the corresponding rate of decay of the shock front. The general theory is applicable to shocks of all strengths where an equation of state can be applied graphically or analytically. A.

534.23 : 534.6 : 534.84

910. Sound absorption and transmission measurements. GIGLI, A. *J. Acoust. Soc. Amer.*, **20**, 839–45 (*Nov.*, 1948).—A report of research performed in the last 10 years in the field of architectural acoustics, with special reference to measurements of sound absorption coefficients of materials and sound transmission losses of partitions. The absorption of sound by systems of resonators is given particular attention. A.

534.231.3 : 534.64

911. Acoustic impedance matching by means of screens. SLAYMAKER, F. H. AND HAWLEY, M. E. *J. Acoust. Soc. Amer.*, **20**, 802–7 (*Nov.*, 1948).—The acoustic impedance of a transducer may be matched to that of the surrounding medium by means of a metal screen. When operating in air, transmission increases of 9 decibels have been obtained by placing correctly selected and positioned screens in front of a crystal transducer. The device narrows the response curve of a sharply resonant transducer only slightly, while the directional characteristics are not measurably altered. The situation is somewhat analogous to the non-reflection coating of optics. For purposes of analysis, a more useful analogue is that of a transmission line containing a discontinuity. Experiments with woven and perforated screens of different geometric form have been performed and the results evaluated. A.

534.232 : 537.365 : 621.395.61

912. An electrokinetic transducer. WILLIAMS, M. *Rev. Sci. Instrum.*, **19**, 640–6 (*Oct.*, 1948).—A description is given of a transducer which utilizes, for the transformation of sonic to electrical energy, the electrokinetic potential developed by the movement of a fluid through a porous solid. The construction and calibration of the transducer are discussed, and results of measurements of the pressure fluctuations in oil pipe lines are presented. A.

534.232 : 621.395.623

913. Systematic theory of electro-acoustical transducers. FISCHER, F. A. *Frequenz*, **2**, 181–90 (*July*, 1948) *In German.*—Abstr. 534 B (1949).

534.232 : 621.395.623.7

914. Study of transient response of loud-speakers. GUYOT, G. *Rev. Gén. Élect.*, **57**, 245–53 (*June*, 1948) *In French.*—Abstr. 535 B (1949).

534.25 : 534.321.9

915. Sound wedge and homogeneous sound lens. ROSENBERG, L. D. *J. Tech. Phys., USSR*, **18**, 11–28 (*Jan.*, 1948) *In Russian.*

534.26

916. On two complementary diffraction problems. STORRUSTE, A. AND WERGELAND, H. *Phys. Rev.*, **73**, 1397–8 (*June* 1, 1948).—Note on exact solutions for the diffraction of sound waves by a circular disc and the corresponding hole. If these be of radius a, it is shown that Babinet's theorem is only valid when $\lambda \ll a$. H. H. HOP.

534.321.9 : 621.3.012.8

917. The ultrasonic interferometer with resonant liquid column. FOX, F. E. AND HUNTER, J. L. *Proc. Inst. Radio Engrs*, **36**, 1500–3 (*Dec.*, 1948).—The ultrasonic interferometer is simple in construction

and operation, and enables the velocity of sound in a liquid to be determined with high accuracy. Formerly, the absorption of sound in the liquid and the coefficient of reflection at the reflector surface was obtained using a complicated analysis of the electrical and equivalent-electrical circuits of the quartz crystal and the associated fluid column. The simplified analysis of the equivalent circuit given is made possible by limiting the discussion to the conditions that exist when all parts of the system (electrical, mechanical and acoustical) are adjusted to resonance. The analysis of the complete electrical and equivalent-electrical circuit is thereby greatly simplified. It is not necessary to analyse the shape of a reaction dip in order to obtain coefficients of absorption and reflection. A.

534.373–8

918. Measurements on the ultrasonic resonance curves in some liquids. VAN ITTERBEEK, A. AND DE BOCK, A. *Portugal. Phys.*, **2** (*Nos* 3–4) 235–42 (1947) *In French.*—Measurements were made of the damping coefficient of a quartz oscillator immersed in various liquids, at frequencies between 530 and 900 kc/s. The damping coefficient was obtained from the energy resonance curve of the system—the energy being deduced from the measured radiation pressure on a disc attached beneath one pan of a precision balance. The results agree with the theoretical calculations of damping coefficient at 530 kc/s for paraffin, xylol and transformer oil, but are about 4× greater at the higher frequencies. G. F. H.

534.414

919. Formula introducing a "shape" factor into the calculation of the resonance frequency of Helmholz resonators. CHERVET, D. AND HENRY, J. *C.R. Acad. Sci., Paris*, **226**, 1891–3 (*June* 7, 1948) *In French.*—Rayleigh's classical formula for the resonance frequency of Helmholtz resonators, involves only the quantities: velocity of sound, area and radius of neck and length of neck. In establishing the formula Rayleigh assumed (1) that the pressure in the interior of the resonator is constant, and (2) that the dimensions of the resonator are small compared with the wavelength corresponding to the resonance frequency. The author has measured the distribution of pressure in the interior of the resonator and shows that it is not constant and that it varies from point to point in accordance with an experimental law which he states. From this he deduces a correction factor to the frequency formula and gives a table comparing experimental and theoretical resonance frequencies for a number of resonators of different shapes (spherical, cylindrical and parallelipiped). The values calculated from Rayleigh's formula depart by 1% to 39% from the experimental values, whilst those calculated from the corrected formula agree with experimental values within 1% in all cases. A. B. W.

534.6 : 534.232

920. Reciprocity calibration of vibration probes. MORROW, C. T. *J. Acoust. Soc. Amer.*, **20**, 826–9 (*Nov.*, 1948).—Apparatus has been developed for calibration of vibration probes, analogous to that for reciprocity calibration of condenser microphones, except that a metallic rod instead of an air cavity couples the 2 transducers. The rod is assumed to act as a mechanical open circuit, whereas the air cavity is assumed to be an acoustic short circuit. The product of the sensitivities of the 2 transducers can be obtained from the current to the driving probe (*A*), the mass of the coupler, and the open circuit voltage of the pick-up probe (*B*). The ratio of the sensitivities of *A* and *B* can be obtained as the ratio of their open-circuit voltages when the coupler is driven by an auxiliary drive. From the product and the ratio, the 2 individual sensitivities can be calculated. A.

534.6 : 621.395.616 : 534.232

921. Reciprocity free field calibration of microphones to 100 Kc in air. RUDNICK, I. AND STEIN, M. N. *J. Acoust. Soc. Amer.*, **20**, 818–25 (*Nov.*, 1948).—A procedure for obtaining a free field reciprocity calibration of a W. E. 640 AA transducer in the frequency range 1–100 kc/s is described. The basis for the calibration is investigated in some detail, particularly with regard to (*a*) the validity of electro-acoustic reciprocity relations applying to the transducer and (*b*) the nature of the acoustic calibrating field. The transducers were found to be reciprocal. Factors affecting the acoustic field are the degree of approximation of the source to a point transducer, the effect of walls of the anechoic room, and the attenuation in the air. It is shown that when the separation of the transducers used in these measurements is 30 cm, the transducers are essentially points, the room produces very little effect, but the attenuation in the air can produce a significant error at high frequencies unless correction is made for it. The results of the calibration of two W. E. 640 AA transducers are presented, giving their responses as speakers and microphones, the latter with and without a protective grid. A.

534.612.2

922. Electro-acoustic measurements on the celebrated Baroque organs of Upper Swabia. I. Sound pressure surveys. LOTTERMOSER, W. *Z. Naturforsch.*, **3a**, 298–308 (*May*, 1948) *In German.*—The relative sound outputs of the different registers in three Baroque church organs were measured with a condenser microphone. T. S. E. T.

534.612.2 : 621.395.616 : 534.232

923. Instrumentation for the measurement of sound pressure level with the Western Electric 640 AA condenser microphone. VENEKLASEN, P. S. *J. Acoust. Soc. Amer.*, **20**, 807–17 (*Nov.*, 1948).—Given the pressure calibration of the W. E. 640 AA microphone, certain instrumentation and complementary calibrations are needed for the convenient use of this microphone under the various conditions encountered during research work. The following aspects of this subject are discussed: (1) Considerations regarding the effect of preamplifier input impedance on the frequency response and noise threshold of a condenser microphone. (2) An a.c. operated, cathode follower type preamplifier and associated circuits. (3) A flexible extension for use with the preamplifier. (4) The use of small probe tubes. (5) Random incidence calibration and collected free field calibrations. (6) A "supercharged" cathode follower circuit and its application as a preamplifier. A.

534.64

924. A comparison of artificial ear couplers. GLASER, J. L. AND MORRICAL, K. C. *J. Acoust. Soc. Amer.*, **20**, 771–5 (*Nov.*, 1948).—Comparison is made of the response of several earphones measured on two different types of earphone couplers. Points of difference are noted and explained. The existence of certain characteristics which might influence the design and use of such couplers is brought out and proposed for further investigation. A.

534.75

925. The early history of hearing—observations and theories. v. BÉKÉSY, G. AND ROSENBLITH, W. A. *J. Acoust. Soc. Amer.*, **20**, 727–48 (*Nov.*, 1948).—19 figs. Extensive bibliography.

534.75 : 534.77 : 534.1 : 612.85

926. Vibration of the head in a sound field and its role in hearing by bone conduction. v. BÉKÉSY, G. *J. Acoust. Soc. Amer.*, **20**, 749–60 (*Nov.*, 1948).—In a sound field the head is set into forced vibrations, and the vibrations are sometimes heard by bone conduction. For clinical purposes it is important to know the magnitude of these vibrations of the head so that, in cases of partial deafness, the roles of air and bone conduction can be understood. The pattern of the head vibrations and the velocity of the deformation waves travelling along the wall of the skull were measured; the velocity $c = 570$ m/sec. A new method of calibrating a vibration pick-up with a sound level meter was developed. An earphone was constructed that reduced the amount of "cross-hearing" to a very low value. With this, hearing thresholds can be measured in many cases without using noise to mask the ear with the better hearing, even though the difference between the sensitivities of the two ears is >40 db. It is shown that the maximal sound insulation that can be obtained with an ear plug is determined by the elastic forces acting between the skin of the ear canal and the bony wall of the ear canal. A.

534.75 : 612.85 : 534.792

927. The role of interaural phase in loudness. HIRSH, I. J. AND POLLACK, I. *J. Acoust. Soc. Amer.*, **20**, 761–6 (*Nov.*, 1948).—Experiments have shown that the interaural phase angle is a critical factor in the masking of pure tones and speech by white noise. This study extends these findings to the role of interaural phase in loudness. It is found that the reduction in loudness which is effected by noise under several conditions of interaural phase parallels the masking that is produced under similar conditions. These effects are marked, however, only at signal-to-noise ratios in the region of the masked threshold. At higher signal-to-noise ratios, approximating listening in the quiet, the effect of interaural phase on loudness is nil. A convenient basis for discussion is provided by considering the masked and masking signals in terms of the figure-ground relation between them. A.

534.75 : 612.85 : 534.792

928. The effect of high altitude on the threshold of hearing. RUDMOSE, H. W., CLARK, K. C., CARLSON, F. D., EISENSTEIN, J. C. AND WALKER, R. A. *J. Acoust. Soc. Amer.*, **20**, 766–70 (*Nov.*, 1948).—The threshold of hearing has been measured in a decompression chamber at ambient pressures corresponding to altitudes of 35 000 ft and sea level. After the data have been corrected for the change of cushion seal and the change in response of the earphone unit with change in pressure, the results show that the shift in the average threshold of hearing for 15 ears is within $\pm 2{\cdot}5$ db of sound pressure level when the density of the air in the outer and middle ear is decreased to about $\frac{1}{4}$ that at sea level. A.

534.78 : 534.792

929. The effects of high altitude on speech. CLARK, K. C., RUDMOSE, H. W., EISENSTEIN, J. C., CARLSON, F. D. AND WALKER, R. A. *J. Acoust. Soc. Amer.*, **20**, 776–86 (*Nov.*, 1948).—The effects of altitude on the human voice have been determined by measuring speech spectra as a function of altitude. The apparatus simultaneously recorded the square of the sound pressure in 12 contiguous bands extending from 60 to 9 000 c/s. 11 talkers were used, and data were obtained in a decompression chamber at constant temperature for altitudes up to 40 000 ft. Special attention was given to the method of monitoring and phonation. Vowels, sibilants, words, and connected speech were used as test material. The results indicate that vowels and semi-vowels exhibit a loss in mean square pressure with altitude roughly proportional to the logarithm of the density ratio, while some consonants are little affected by altitude. Measurements indicate that the number of words spoken on one breath of air is proportional to air density if constant sound pressure output is required. Normally, at 35 000 ft it is necessary to pause for breath about 2 to 3 times as frequently as at sea level. A.

534.781 : 534.44

930. Quantitative amplitude representation in sound spectrograms. KOENIG, W. AND RUPPEL, A. E. *J. Acoust. Soc. Amer.*, **20**, 787–95 (*Nov.*, 1948).—The sound spectrograph shows variations in signal intensity by varying shades of grey to black which, because of the nature of the recording medium, are not susceptible to quantitative interpretation. Several methods are described in this paper for recording amplitude variations in measurable steps. These methods include contours, dot spacing, distinctive shadings, and variable area patterns. A.

534.781 : 534.44

931. Amplitude cross-section representation with the sound spectrograph. KERSTA, L. G. *J. Acoust. Soc. Amer.*, **20**, 796–801 (*Nov.*, 1948).—Spectrograms as normally produced by the "sound spectrograph" are 3-dimensional. Time is portrayed along the length of the spectrogram paper, frequency across it, and amplitude by the blackness of the marking. The time and frequency scales thus provided are adequate for most analysis purposes. The amplitude scale, however, is poorly defined, first because inherent characteristics of the spectrogram paper limit the amplitude portrayal to a highly non-linear and limited range; secondly, because reading degrees of blackness by eye is inaccurate. This inadequacy in determining amplitude led to the development of a method for portraying amplitude which was independent of the characteristics of the paper or of the ability of the eyes to delineate grades of blackness of marking

The device described provides an auxiliary presentation which portrays, at any preselected point in time, a 2-dimensional spectrogram with axes of amplitude and frequency. This device delineates a 35 db amplitude range with the scale in uniform logarithmic steps. A.

534.833 : 534.23 : 534.21

932. On the propagation of sound over snow. WATSON, R. B. *J. Acoust. Soc. Amer.*, **20**, 846–8 (*Nov.*, 1948).—Many qualitative observations have been made on the quieting effect of newly fallen snow. This natural phenomenon must depend on the acoustical properties of such a layer of snow. The physical constants for snow vary over a considerable range, and data for calculating the acoustic constants of snow are meagre. The calculated absorption coefficient ranges uniformly from 0·25 at 100 c/s to 0·75 at 2 000 c/s. Calculations are made of the sound level at an observer's position due to sound transmitted over a layer of snow. Because of the appreciable absorption, the sound level is found to be considerably reduced at distances as small as five hundred feet from the source. A.

534.833 : 534.23 : 534.21

933. The attenuation of audible sound in fog and smoke. KNUDSEN, V. O., WILSON, J. V. AND ANDERSON, N. S. *J. Acoust. Soc. Amer.*, **20**, 849–57 (*Nov.*, 1948).—Measurements of the rate of decay of sound in a reverberation room, first with no fog or smoke in the room and then with fog or smoke of known concentration and particle size added to the room, show that the attenuation of sound in a number of aerosols is in approximate agreement with values predicted by the theories of Sewell, Epstein and Oswatitsch. In a water fog having a concentration of $2{\cdot}0\times10^{-6}$ g/cm³ and average droplet radius of $6{\cdot}25\times10^{-4}$ cm, the attenuation owing to the fog increased from about 5 db/sec at 500 c/s to 13 db/sec at 8 000 c/s. In a quite similar fog of mineral oil, the corresponding attenuation increased from 1·6 db/sec at 500 c/s to 21 db/sec at 8 000 c/s. At very low frequencies, a fog of water is much more absorptive than is a fog of oil; the difference is ascribed to a "relaxation" effect of evaporation from and recondensation on the droplets, which is $\gg$ for water than for oil. The attenuation of sound in smoke may become rather high, amounting to 58 db/sec at a frequency of 6 000 c/s for a moderately dense smoke of NH_4Cl (180 g in a volume of 6 080 ft³). A.

534.85

934. Vibrators for measurement of response and compliance of phonograph pick-ups. PEARSON, H. A., CARLISLE, R. W. AND CRAVIS, H. *J. Acoust. Soc. Amer.*, **20**, 830–3 (*Nov.*, 1948).—Two vibration instruments are described. The first is a vibrator having substantially constant amplitude over a wide frequency range. A small reed is milled from a solid block of steel and driven with a conventional magnetic system. A light platform with a grooved Nylon pad is attached to the end of the reed. A phonograph pick-up is laid on this platform as on a record, and the response from 30 to 10 000 cycles may be measured. The second is a vibrator having an armature with considerable mass and negligible stiffness. The armature is pivoted and retained by magnetic attraction with no restoring spring. A platform is provided on this armature on which to rest a pick-up. From the frequency of resonance of the armature with the stiffness of any pick-up or other vibrator, the stiffness of such a vibrator may be readily ascertained, as in Abstr. 2819 (1947). Calibration data were secured from both dynamic and static measurements, the agreement of which is indicated. A.

534.851 : 621.317.39

935. The light-pattern meter. SANTO, R. E. *Proc. Inst. Radio Engrs*, **36**, 1431–3 (*Nov.*, 1948).—A new meter which determines the amplitude of sine waves recorded on discs is described. It is accurate to 0·5 db and obviates the need of a dark room for measurement of the useful "Christmas-tree pattern." A.

534.862.3 : 621.396.97

936. Sound recording as applied to broadcasting. PULLING, M. J. L. *B.B.C. Quart.*, **3**, 1–14 (*July*, 1948).—Abstr. 587 B (1949).

OPTICS . RADIATION . SPECTRA 535

535.23

937. A proof of Wien's displacement law by the theory of dimensions. GLASER, W. *S.B. Akad. Wiss. Wien.*, **156**, *Abt. IIa* (*Nos* 1–2) 87–92 (1948) *In German.*—Wien's general law of radiation is derived by the theory of dimensions. The coefficients and powers of the relevant dimensional quantities are found from the fact that the required law is invariant when different units of length, time, energy and temperature are employed. The method also enables the values of the Boltzmann and Planck constants (k and h) to be determined from purely empirical observations. V. W. R.

535.231.4

938. The spectral emissivity of iron and cobalt. WAHLIN, H. B. AND KNOP, H. W., JR. *Phys. Rev.*, **74**, 687–9 (*Sept.* 15, 1948).—The spectral emissivity of Fe and Co has been determined as a function of the temperature. Sharp, definite changes in the emissivity have been observed in Fe at the A_3 and A_4 point and at the Curie temperature for Co. A gradual change takes place in Co in the region where, presumably, the Co structure changes from hexagonal to cubic. A decrease in the neighbourhood of 1 370°K has been observed for Fe. A.

535.231.4 : 669.018

939. The emissivity of iron–tungsten and iron–cobalt alloys. KNOP, H. W., JR. *Phys. Rev.*, **74**, 1413–16 (*Nov.* 15, 1948).—The spectral emissivity at $\lambda = 0{\cdot}667\ \mu$ has been determined for an 18% W–Fe alloy and a 40% Fe–Co alloy. Changes have been detected at the peritectoid and peritectic reaction temperatures for W–Fe and at the A_3 point for Fe–Co. Emissivity changes found at 1 044°K and 1 292°K in Fe–Co are attributed to the order-disorder transition and the ferro- to para-magnetic transformation, respectively. The resistivity of 40% Fe–Co has been determined as a function of temperature. A.

535.24

940. Photometric sector disc with aperture variable during operation. BAYLE, A. *Rev. Opt.* (*Théor. Instrum.*) **27**, 314–15 (*May*, 1948) *In French.*—Illustrates, with constructional details, a sector disc such that equal movements of the control lever always give approximately equal changes in density. The disc is carefully balanced, 50 cm dia., and operates at 1 000 r.p.m. It has functioned satisfactorily for 2 years. N. C.

535.247.4 : 535.379

941. Photoelectric photometry of artificial luminophores of limited activity. FRIEDMANN, S. A. AND CHECHUK, N. O. *J. Tech. Phys., USSR*, **18**, 35–8 (*Jan.*, 1948) *In Russian.*

535.31 : 537.531

Lenses for X-rays. *See Abstr.* 1052

535.312

942. On the determination of plane mirrors in instruments for observation. BLOTTIAU, F. *Rev. Opt.* (*Théor. Instrum.*) **27**, 341–50 (*June*, 1948) *In French.*—A system consisting of alternate axially symmetrical refracting members and plane reflectors is considered, having at least 4 mirrors, in order to transform a given trihedron in the object-space into a trihedron in the image-space in the same sense. It is shown that it is possible to reduce the number of mirrors to 2. Formulae are given by means of which the mirrors may be calculated. H. H. HOP.

535.317.4

943. On the primary spherical aberration of thin lenses. BOUYER, R. *Rev. Opt.* (*Théor. Instrum.*) **27**, 288–94 (*May*, 1948) *In French.*—A new treatment establishing the known results. H. H. HOP.

535.317.9

944. On the theory of aplanatic aspheric systems. WASSERMANN, G. D. AND WOLF, E. *Proc. Phys. Soc., Lond., B*, **62**, 2–8 (*Jan.*, 1949).—Methods are described for the design of two aspheric surfaces for any given centred system, so as to achieve exact aplanatism. The practical application of the methods is illustrated by the design of a reflecting microscope. A.

535.317.9 : 535.81

945. On the designing of aspheric surfaces. WOLF, E. *Proc. Phys. Soc., Lond.*, **61**, 494–503 (*Dec.*, 1948).—A method is developed for the design of an aspheric surface to ensure axial stigmatism in any given centred optical system. It is shown that when the surface is in the interior of the system the determination of its profile depends on the solution of a certain transcendental equation. An iterative method is described which gives the profile to any desired degree of accuracy. When the corrector is the last surface of the system the solution is greatly simplified, and for such cases exact parametric equations, involving quantities which can easily be obtained from a ray trace, are given. A.

535.33 : 535.89 : 536.46

946. Some spectroscopic observations on pyrotechnic flames. BARROW, R. F. AND CALDIN, E. F. *Proc. Phys. Soc., Lond., B*, **62**, 32–9 (*Jan.*, 1949).—The results of a spectroscopic study of the white or coloured flames from typical pyrotechnic compositions are reported. Most of the visible light from these sources comes from a limited number of atomi or diatomic emitters. The effects of secondar emitters on the dominant wavelength, colorimetri purity and relative intensity are considered in genera terms and some suggestions for improving the qualit of the flames are put forward. A

535.33.072 : 545.82

947. The quantometer, a direct reading instrumen for spectrochemical analysis. HASLER, M. F., LIND HURST, R. W. AND KEMP, J. W. *J. Opt. Soc. Amer.*, **38**, 789–99 (*Sept.*, 1948).—The spectrometer equippe with movable receivers is discussed from the stand point of basic optical, mechanical and electrica design. An arrangement of 4 bridges with 3 receiver on each, allows up to 12 receivers to be moved an positioned so as to receive light from a great variet of line arrays. The limitations in this respect ar presented for instruments utilizing 24 400 line/i gratings and 36 600 line/in gratings, both with a 1·5 m curvature. The basic electrical circuits an constants are given in detail for the receiver units, th low and high voltage power supplies, the sensitivity controls, and the recorders. The recording console i described especially with regard to the interchangeable panel method of direct reading, suitable for the analysis of a wide variety of alloys of the same base material General operating methods are discussed in some detail. Adjusting and testing the instrument are explained and the precision of the unit as a light measuring device is indicated. A

535.338 : 537.527.5

948. The continuous spectrum of the high-pressure mercury discharge. ELENBAAS, W. *Philips Res. Rep.*, **2**, 442–53 (*Dec.*, 1947).—The intensity of the continuous spectrum (c.s.) of the h.p. Hg discharge was measured between ¼ and 25 atm. for inputs from 20 to 60 W/cm and for diameters between 6 and 60 mm. The ratio of the intensity of the continuum to the intensity of the yellow lines 5 770/91 is almost independent of the input and increases linearly with the mean vapour density m/d^2. The ratio at $m/d^2 = 0$ is ascribed to recombination of electrons with ions, whereas the contribution $\propto m/d^2$ originates from molecular radiation. A rough energy balance is given in which the line energy and the energies radiated in the two types of c.s. occur. Using this equation the absolute value of the intensity of the c.s. of the u.v. standard is $> 2\times$ the value measured by Rössler [Abstr. 1486 (1948)]. The discrepancy between the measured and calculated gradient between 1 and 5 atm. disappears on using this energy-balance equation. The remaining discrepancy at higher pressures is probably due to the diminution of the ionization potential at these high densities. The magnitudes of these diminutions necessary to account for the measured gradients are tabulated as a function of the mean v.d. A.

535.338 : 539.153

Configurations d^2sp, d^3p, d^7p. Terms of Ti I and Ti II. *See Abstr.* 1125–7

535.338.32 : 539.152.2 : 548.0

949. The dipolar broadening of magnetic resonance lines in crystals. VAN VLECK, J. H. *Phys. Rev.*, **74**, 1168–83 (*Nov.* 1, 1948).—In regular crystals, the width of the absorption lines arising from the magnetic

moment of the electron or nucleus is caused primarily by the interaction between the magnetic dipoles. It is prohibitively difficult to determine the precise shape of the absorption line theoretically, but the invariance of the diagonal sum in quantum mechanics permits the calculation of the second moment of the frequency deviation, and hence the r.m.s. line breadth. The latter agrees excellently with the observations of Pake and Purcell on the magnetic absorption of the F nucleus in CaF_2, both in absolute magnitude and in the dependence on the direction between the magnetic field and the principal cubic axes. The fourth moment was also computed to examine how good an approximation is the conventional assumption of a Gaussian shape. As long as no exchange is present (the nuclear case) the Gaussian model is moderately good. For the 100 direction in a cubic crystal, the theoretical ratio of root mean fourth to root mean square breadth is 1·25. Pake and Purcell's measurements yield 1·24. A Gaussian model would require 1·32. The theory is extended to include crystals with 2 kinds of spin moments (2 types of nuclei, or simultaneous nuclear and electronic spin). Coupling between unlike moments is less effective (by a factor $\frac{2}{3}$ in the r.m.s. width) than that between like in broadening the lines. In the paramagnetic absorption caused by electronic spin, it is imperative to include the effect of exchange coupling. This interaction does not contribute to the 2nd moment, but greatly increases the 4th. As a result, the lines are peaked much more sharply than corresponds to the second moment with the Gaussian model for line shape. This "exchange narrowing" explains why microwave paramagnetic absorption lines are much narrower than one first conjectures from the amount of dipolar coupling. A.

535.338.332/.333

950. The internal intensity ratio of H_α and of D_α. Hsueh, C.-W. *Phys. Rev.*, **74**, 670–6 (*Sept.* 15, 1948).—A Geissler–Wood discharge tube was designed for use as the light source of H_α or D_α line. The tube was cooled in liquid air under low pressure to reveal the fine structure of the spectral lines. Four different separations, 7·6, 7·8, 8·0 and 8·2 mm, were used in the Fabry–Perot interferometer. 10 spectroscopic plates were measured for H_α and 10 others for D_α. The internal intensity ratios of H_α and of D_α were found to be $0·808 \pm 0·004$ and $0·803 \pm 0·003$, respectively, as compared to the theoretical value of 0·806. This study indicates that the experimental value of the intensity ratio between the two main component groups agrees with the theoretical value when pure H_2 or pure D_2 gas is used in the discharge tube and the discharge is at its maximum intensity. A.

535.341

951. Determination of the potential energy curves for the excited states of HBr and HI: comparison of calculated and experimental extinction coefficients. Romand, J. *C.R. Acad. Sci., Paris*, **227**, 117–19 (*July* 12, 1948) *In French.*

535.343.213–15 : 536.42

952. Infra-red spectra and state of aggregation. II. Richards, R. E. and Thompson, H. W. *Proc. Roy. Soc. A*, **195**, 1–12 (*Nov.* 12, 1948).—In continuation of earlier work [Abstr. 1202 (1948)] on the correlation of infrared absorption spectra of matter in different states of aggregation, the vibrational spectra of a number of substances have been measured in the solid and liquid states. These included paraffins, aromatic hydrocarbons and their simple derivations. The alterations in spectrum which occur on melting are complex, and few generalizations can be made. Attempts have been made to consider them in terms of the assignment of vibration bands to certain atomic groupings, but it seems probable that before the results can be satisfactorily understood it will be necessary to know more about the internal structure of the solid substances. A.

535.343.4–14 : 538.615

953. The Zeeman effect in microwave molecular spectra. Jen, C. K. *Phys. Rev.*, **74**, 1396–1406 (*Nov.* 15, 1948).—A microwave cavity spectroscope is described, which possesses a high sensitivity and resolution for the observation of the Zeeman effect of molecular absorption lines in the microwave frequency range. The theory of operation for this spectroscope and the criteria for sensitivity are formulated. The Zeeman effect of a number of microwave spectral lines has been measured for the gas molecules $N^{14}H_3$, $N^{15}H_3$ and CH_3Cl^{35}, and observed for CH_3Cl^{37} and SO_2. All the experimental results obtained so far can be satisfactorily explained by the combined magnetic contribution due to nuclear and molecular g-factors, if there exists a spin-rotation coupling, or solely by the magnetic contribution due to molecular rotation, if there is no such coupling. Thus, further knowledge of the nuclear and molecular magnetic properties of molecules can be obtained through the examination of the Zeeman effect in microwave absorption spectra. A.

535.343.4–14 : 539.132

954. Erratum: On the fine structure in the inversion spectrum of ammonia. Henderson, R. S. Letter in *Phys. Rev.*, **74**, 626 (*Sept.* 1, 1948).—See Abstr. 3692 (1948).

535.343.4–14 : 621.396.11 : 538.569.4

Atmospheric absorption of the millimetre waves. *See Abstr.* 1108

535.343.9.08 : 535.39 : 539.215.4

955. Quantitative measurements on absorption spectra of solids in reflection. Kortüm, G. and Kortüm-Seiler, M. *Z. Naturforsch.*, **2a**, 652–7 (*Nov.–Dec.*, 1947) *In German.*—Admixture of finely-powdered material with K_2CrO_4 enabled the influence of particle size, incident angle, angle of reflection and other factors on the intensity of the light reflected from the surface to be ascertained.

W. R. A.

535.345 : 535.81

956. Measurement of the transmittivity of optical glass. Smith, T. *Rev. Opt.* (*Théor. Instrum.*) **27**, 371–3 (*June*, 1948) *In English.*—It is shown that by measuring the reflection factors R, R' for left-right and right-left passage of light through a block of glass, together with the overall transmission T, the transmittivity of the glass t may be determined by solution of the equation $1/t - t = [(1 - R)(1 - R')/T] - T$. An accuracy comparable with that of other methods is claimed. H. H. HOP.

535.345.6 : 612.84

957. Spectral-transmissive properties and use of eye-protective glasses. Stair, R. *Circ. U.S. Bur. Stand.*

(*No.* 471) 34 *pp.* (*Feb.* 25, 1948).—Contains spectral-transmissive data curves on most of the widely distributed brands and types of glasses employed in protecting the eyes from harmful ultraviolet, visible, or infrared radiant energy. The standardization of shade numbers for protective glasses used in industry, glasses for special welding operations, the use of coloured glasses for night driving and the elimination of glare in sunlight are given considerable attention. A.

535.37

958. Kinetics of the after-glow of crystallophosphors. ADIROVICH, E. I. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 3) 361–4 (1948) *In Russian.*—A comprehensive theory, based on Blokhintsev's [*J. Exp. Theor. Phys.*, **7**, 1242 (1937)] and de Groot's [Abstr. 1625 (1939)] kimetic differential equations. The rigorous mathematical theory is in complete agreement with previous results obtained by the author in the whole range of phenomena of sustained afterglow, excluding only the short initial spontaneous stage. The kinetics and duration of the spontaneous afterglow, of which the author previously had considered only the special case of the so-called total excitation [*Dokl. Akad. Nauk, SSSR*, **57**, 133 (1947)], is also treated quite generally. The results are everywhere compared with the special solutions due to other workers. Bibliography of 11 entries. B. F. K.

535.37 : 535.343.32 : 532.133

959. The dependence of the duration of phosphorescence of organo-luminophores on the viscosity of the solvent. SVESHNIKOV, B. Y. AND DIKUN, P. P. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 4) 571–4 (1948) *In Russian.*—Although the influence of the viscosity of the medium on the luminescence of organophosphors has long been known, the phosphorescence of liquid media was observed only in comparatively recent times. It is rather infrequent and of low intensity. Yet its great importance for studying the conversion of the energy of excitation into thermal energy cannot be doubted. Varilov and his pupils established the linear dependence between the duration of the phosphorescence of inorganic phosphors and the viscosity of the solvent, whilst the dependence for organic luminophores is definitely more complex. The paper is devoted to a more detailed investigation based on more abundant experimental materials. The main object was the investigation of the interesting properties of orange rhoduline, the only substance showing an appreciable effect down to a viscosity of 0·2 poises. As upper limit solid sugar candy was taken. The solvents were selected from those which may be regarded as inert viscous liquids, viz. alcohols, sugar solutions and sometimes H_2O. A satisfactory agreement was found for different liquids of equal viscosity. The previously established fact that the duration of the phosphorescence changes more slowly than the viscosity was corroborated. The range of observations was extended to 7×10^5 poises. The character of the curves closely resembles that of output curves. This, taken together with all the other available experience, admits of no other explanation than of a definite extinction effect of the solvents, as though a viscous medium acted as a force stabilizing an anomalous configuration of the molecule. The mechanism of this action cannot be described yet.

B. F. K.

535.371

960. Erratum: The relation between efficiency and exciting intensity for zinc-sulfide phosphors. KLASENS, H. A., RAMSDEN, W. AND CHOW QUANTIE. *J. Opt. Soc. Amer.*, **38**, 649 (*July*, 1948).—See Abstr. 1208 (1948).

535.371 : 548.0

961. Resonance transfer of electronic energy in organic crystals. BOWEN, E. J., MIKIEWICZ, E. AND SMITH, F. W. *Proc. Phys. Soc., Lond., A*, **62**, 26–31 (*Jan.*, 1949).—This has been examined by measuring the fluorescence in visible or u.v. light of the systems naphthalene–anthracene, anthracene–naphthacene, naphthacene–pentacene, anthracene–acridine, anthracene–phenazine, and anthracine–di- and hexabromobenzenes. The conditions for "exciton" trapping and the relations of resonance transfer to fluorescence quenching are discussed. A.

535.371 : 666.113

962. The fluorescence of hexavalent uranium in glass. KRÖGER, F. A., STEVELS, J. M. AND BOTDEN, T. P. J. *Philips Res. Rep.*, **3**, 46–8 (*Feb.*, 1948).—In glasses hexavalent U may be present as uranyl groups or as uranate groups. The uranyl groups give rise to fluorescence at room temp., but both uranyl and uranate groups show fluorescence at low temps. It is shown that there is a direct relation between the emission bands and the absorption bands. A.

535.417

963. The interference pattern of two neighbouring radiations in a Hilger prism interferometer. TSIEN, L. C. *Proc. Phys. Soc., Lond.*, **61**, 504–10 (*Dec.*, 1948).—When two neighbouring radiations are applied to a Hilger prism interferometer, an interference pattern of two sets of fringes is obtained. These sets can be arranged at different orientations, when a system of grey bands results from their intersection. Characteristics of these bands are described, and a theoretical consideration is given. The possibility of applying the effect to the resolution of spectral lines is discussed. A

535.42 : 535.13

964. Electromagnetic theory of the diffraction by opaque screens. DURAND, E. *C.R. Acad. Sci., Paris* **226**, 1972–4 (*June* 14, 1948) *In French.*—In the case of scalar disturbances Kirchhoff's integral can be replaced by one formed by the superposition of plane waves. Formulae of the same type are given for the E–M case. It is claimed that the formulae are preferable to those of Kottler since a discontinuity in the screen introduces only one singularity instead of two. Unlike those of Luneberg the present formulae do not require a knowledge of the gradient normal to the wave.

H. H. HOP

535.422

965. The disturbance near the focus of waves of radially non-uniform amplitude. HOPKINS, H. H. *Proc. Phys. Soc., Lond., B*, **62**, 22–32 (*Jan.*, 1949).—Lommel's problem, the disturbance near the focus of waves of uniform amplitude, is generalized to consider waves of radially non-uniform amplitude. Lommel's numerical results are extended, and his U and V functions, tabulated on a new basis, together with some new related functions, are employed to provide extensive intensity distribution curves for the diffract

ing patterns associated with waves of both uniform and non-uniform amplitude. A.

535.424

966. On the resolving power of optical instruments. RONCHI, V. *Rev. Opt.* (*Théor. Instrum.*) **27**, 353–68 (*June*, 1948) *In Italian.*—A general critical review of the theory of photographic and visual resolving power. H. H. HOP.

535.424 : 535.31

967. Study of the combined effects of diffraction and geometrical aberrations on the image of a luminous point. III. MARÉCHAL, A. *Rev. Opt.* (*Théor. Instrum.*) **27**, 269–87 (*May*, 1948) *In French.*—A pinhole (0·04 mm dia.) was illuminated by light ($\lambda = 0{\cdot}5461\ \mu$) and imaged by means of well-corrected objectives. By means of a projection lens the image so produced was thrown upon a photographic plate, from which the distribution of intensity in the diffraction pattern was determined. The effect of finite size of the source was eliminated by "reducing" the experimentally determined distribution using a graphical method. Light distribution curves and image photographs for the Airy disc, out-of-focus and astigmatic cases are given; and it is concluded that both the application of Huyghen's principle in theoretical considerations and the mechanical integrations given earlier [Abstr. 2765 (1948)] are of sufficient accuracy. H. H. HOP.

535.43

968. Light scattering by sucrose solutions at high concentrations. HALWER, M. *J. Amer. Chem. Soc.*, **70**, 3985–6 (*Dec.*, 1948).—Absolute turbidities of solutions of pure sucrose have been determined up to a concentration of 0·6 g/mol. of solution. The turbidity increases with concentration, reaching a maximum at $\sim 0{\cdot}4$ g/mol., then decreases. The theoretical turbidity curve derived from osmotic pressure data shows the same effect. The results confirm the validity of the theory. A.

535.43 : 551.463

969. Radiation theory of the hydrosphere. LAUSCHER, F. *S.B. Akad. Wiss. Wien*, **155**, *Abt. IIa* (*Nos* 7–8) 281–308 (1947) *In German.*—A mathematical treatment of the theory of scattering by small particles, as applied to the scattering of light in sea water. The results obtained are concordant with experimental values given by other authors. J. W. T. W.

535.557

970. Interpretation, by fluctuation of orientation, of the state of polarization of light diffused by liquid crystals. CHATELAIN, P. *C.R. Acad. Sci., Paris*, **227**, 136–8 (*July* 12, 1948) *In French.*—A preparation of *p*-azoxyanisole, orientated parallel to the axis, scatters incident polarized light strongly, the most intense vibration of the scattered light being $\perp$ the incident vibration. This effect is shown to result from variations in orientation of the liquid crystal. A. J. M.

535.568.1

971. An improvement of Savart's polariscope. RICHARTZ, M. *J. Opt. Soc. Amer.*, **38**, 623–5 (*July*, 1948).—In the use of the Savart polariscope to determine directions of vibration of polarized light 4 "zero positions" have to be found accurately. The reasons why the usual methods employed are not satisfactory are given and an improved method, in which a crystalline sheet having a rectangular opening in the centre is placed in front of the Savart plate, is described. The sheet may be of cellophane cut with its principal direction parallel to the long sides of the rectangle: for monochromatic light a $\lambda/4$ wave plate is better. The probable error of setting is less than 1′ compared to 1·5′ with the usual arrangement. The method appears advantageous for use with Wild's polarimeter. H. G. J.

535.8

972. Criteria defining the quality and performance of visual optical instruments. ARNULF, A. *Rev. Opt.* (*Théor. Instrum.*) **27**, 303–7 (*May*, 1948) *In French.*—A summary of the criteria upon which the testing methods employed at the Institut d'Optique are based. H. H. HOP.

535.8

973. Experimental study of various night instruments. ARNULF, A., FLAMANT, F. AND FRANÇON, M. *Rev. Opt.* (*Théor. Instrum.*) **27**, 308–13 (*May*, 1948) *In French.*—A series of 5 telescopes was tested using a Foucault test chart of unit contrast, illuminated by natural light. It was found that the "absolute efficiencies" varied with the illumination. For two instruments A, B of exit pupil diameters 10 and 6 mm, transmissions 0·85 and 0·55 and brightness ratio $C_A/C_B = 2{\cdot}9$, it was found that the ratio of absolute efficiencies was almost unity in daylight. The ratio was found to increase with decreasing illumination, passing through a maximum of 3–5 according to the observer. The ratio then decreased to a steady value of 1·5, afterwards increasing to ∞ at very low brightness. It is concluded that for use at night instruments should have the greatest possible brightness. H. H. HOP.

535.82

974. Elementary theory of the phase-contrast microscope. BALLERINI, L. *Nuovo Cim.*, **5**, 121–32 (*June*, 1948) *In Italian.*—Gives formulae for the constants of the diffraction plates giving best results in different cases. H. H. HOP.

535.82

975. Theory of phase-contrast microscopy. BERTI, L. *Nuovo Cim.*, **5**, 133–9 (*June*, 1948) *In Italian.*—A general formulation of phase-contrast diffraction theory. H. H. HOP.

535.824.8

976. Records of the colour aberrations of high-power microscope objectives. WILSON, E. T. *Phot. J.*, **88 B**, 116 (*Sept.–Oct.*, 1948).—To test the colour-correction of objectives, microphotographs are taken, with Hg–Cd illumination, of a scratch in a silvered plate, tilted at a slight angle to the normal object plane. A grating and prism separate out the spectral images, and the position of best focus for each line is thus recorded. Four sample records are shown.

535.83

977. National Physical Laboratory apparatus for measuring the dioptric power of telescopes. SMITH, T. *Rev. Opt.* (*Théor. Instrum.*) **27**, 377–81 (*June*, 1948) *In English.*—Description of an instrument for checking the focusing scales of telescopes, in which the curvature of the emergent wavefront in the plane of the exit pupil

is measured in dioptres. The range ±5D is measurable with an accuracy of ⅛D. H. H. HOP.

535.834

978. National Physical Laboratory apparatus for measuring the departures from parallelism of binocular telescopes. SMITH, T. *Rev. Opt.* (*Théor. Instrum.*) **27,** 374–6 (*June*, 1948) *In English.*—An instrument employing an autocollimating method in which the 2 components of the error are separately measured. Since the light passes forwards and backwards through the instrument under test, relative rotation of the images is not detected by the method. H. H. HOP.

HEAT 536

536.2

979. Influence of humidity on the thermal conductivity of granular bodies. DEVIENNE, M. *C.R. Acad. Sci., Paris*, **226,** 1512–13 (*May* 10, 1948) *In French.*—The influence on the apparent thermal conductivity of the water condensed in a bed of glass balls of dia. 3·3 mm has been studied. A metal cylinder of balls was plunged into a cold bath, the change of temperature at the centre giving the thermal diffusivity and hence the thermal conductivity. The major factor appears to be the liquid film at the points of contact and a simple law is given correlating the coefficient and the mass of water per litre. The apparent conductivity is however also affected by distillation from the warm to the cold parts. W. C. M.

536.2.01 : 517.947.43

980. An observation on heat sources placed at random on a surface. WANNIER, G. H. *J. Appl. Phys.*, **19,** 1020–2 (*Nov.*, 1948).—A mean value theorem and a fluctuation theorem are derived for the case where a potential is due to sources of potential placed irregularly on a surface. The purpose of the theorems is to provide a check on theories of solid-solid friction where extremely high "local temperatures" are sometimes assumed. The result indicates that a certain caution should be exercised in using such concepts. A.

536.2.022 : 536.221

981. Bidwell's intercept relation and the thermal conductivity of liquid metals. POWELL, R. W. *J. Appl. Phys.*, **19,** 995–6 (*Nov.*, 1948).—A note pointing out that the claim made by Bidwell and Hogan [*J. Appl. Phys.*, **18,** 776 (1947)] that the relation $k/\rho C = K(1/T) + K'$, where k is the thermal conductivity, ρ the density, C the specific heat, T the absolute temperature and K and K' are constants, holds for Al, Sn, Pb and Zn with the intercept, K', the same for the solid and liquid phase, is not so well supported by experimental evidence as the reader is led to believe. The latest paper on Al makes no reference to Konno's appreciably different results for the thermal conductivity of liquid Al. Furthermore, adjustment appears necessary in the plotting of Bidwell and Hogan's two points for the liquid phase and this brings the intercept for the liquid phase about 30% above that for the solid phase. Of the other three metals cited by Bidwell and Hogan as having been previously shown to conform to the intercept relationship, it is revealed that Zn does not on the experimental evidence of both Bidwell and Konno, Pb does on the evidence of Bidwell but not on that of Konno, whilst Sn does on the evidence of Konno only. Further experimental investigation is clearly necessary before any definite relationship such as that suggested can be accepted. A.

536.23 : 533.15 : 533.16

Thermal conductivity of air. *See Abstr.* 893

536.24

982. The mechanism of the deposit of frost on an internally cooled body. BRUN, E. AND FENIGER, K. *C.R. Acad. Sci., Paris*, **226,** 1966–7 (*June* 14, 1948) *In French.*—The mass of frost deposited on internally cooled tubes, such as cooled brine pipes, calculated by considering the condensation of water vapour from the ambient air and using the laws of thermal exchange and diffusion, is lower than that found experimentally. The explanation given is that, the frost being porous, sublimation of the vapour takes place not only on the exterior surface of the frost but also in the interior. Evidence in support of this is quoted. By placing thermocouples in the frost at various distances from the tube surface the coefficient of thermal conduction was found to increase steadily with time, indicating the increasing compactness of the layers of ice close to the tube. S. W.

536.24 : 532.526 : 533.6.011

983. Heat transfer from a rotating disk to ambient air. WAGNER, C. *J. Appl. Phys.*, **19,** 837–9 (*Sept.*, 1948).—The coefficient of heat transfer from a rotating disc to ambient air in case of a laminar boundary layer is theoretically calculated on the basis of von Kármán's calculation of flow conditions. A.

536.24 : 532.542

984. Heat transfer in a laminar flow of liquid through short pipes. SHMUSHKEVICH, T. M. *J. Tech. Phys., USSR*, **18,** 29–34 (*Jan.*, 1948) *In Russian.*—The temperature distribution for the problem was determined, and the heat flux at the tube outlet found to be proportional to $(\chi L)^{\frac{1}{3}}$, where L is length of the tube, χ the coefficient of temperature conductivity of the liquid. A.

536.24.02.023 : 518.424

985. Solution of problems of heat transfer by plane thermal waves by graphical method. SHKLOVER, A. M. *J. Tech. Phys., USSR*, **18,** 925–48 (*July*, 1948) *In Russian.*—In earlier papers the author had developed a novel method for solving problems of heat transfer by plane thermal waves, using complex representation [*C.R. Acad. Sci., USSR*, **45,** 114 (1944)]. In the present, new concise and convenient graphs for calculation are given, based on the said method. Their use and advantages are explained with practical examples, the solution of which by the exact formulae of Vlasov [*Bull. Thermotechn. Inst.* (*No.* 3) (1927)], Seliverstov [*Thermal stability of buildings* (1934)], Muromov [*Calculated temperatures of the outer air and thermal stability of buildings* (1939)] and Shvidkovski (*J. Tech. Phys.*, **10** (*No.* 2) (1940)] would meet insuperable difficulties. The principles of construction of these graphs are pointed out and, apart from those providing strict solutions, simplified graphs are given for finding approximate solutions. A.

536.24.08 : 621.317.39

986. Heat- and mass-flow analyser—a tool for heat research. PASCHKIS, V. *Metal Progr.*, **52**, 813–18 (1947).—With this analyser, heat-flow problems can be studied by electrical measurements in appropriate combinations of resistances and capacitances, since the mathematical formulae for heat flow in solids and electrical flow in certain types of circuits have the same form. A heat- and mass-flow analyser laboratory and the procedure adopted in studying a problem in heat flow are described. Examples of the application of the method to the study of metallurgical problems concerning furnace construction, operation of controls, solidification of ingots and castings, and the efficiency of open-hearth regenerators are cited. B. A.

536.25

987. The dissipation of heat by free convection from vertical and horizontal cylinders. ELENBAAS, W. *J. Appl. Phys.*, **19**, 1148–54 (*Dec.*, 1948).—This paper gives a simpler deduction of formulae given previously [Abstr. 3176–7 (1947)]. A.

536.33 : 530.24 : 535.43

988. Radiation and heat conduction in light-scattering material. IV. Various extensions and a generalized theory. HAMAKER, H. C. *Philips Res. Rep.*, **2**, 420–5 (*Dec.*, 1947).—In previous papers [Abstr. 2867 (1947)] only simplified problems have been considered. For a fuller discussion of many practical questions of a similar kind some extensions of the theory may be required (indicated in the paper). A.

536.4.032

989. On the construction of a recording cryometer and the cryoscopy of borates in a saline medium. DOUCET, Y. AND ROLLIN, M. *C.R. Acad. Sci., Paris*, **226**, 1967–8 (*June* 14, 1948) *In French.*—A cryometer with photographic recording and utilizing supercooling is described. The sensitivity is such that measurements can be made to $\simeq \frac{1}{4} \times 10^{-3}$ degree. H_3BO_3, $NaBO_2$ and $Na_2B_4O_7$ have been examined and 1·72 determined for the cryoscopic constant. [See Abstr. 2134 (1939)]. S. W.

536.423 : 532.7

The theoretical treatment of the evaporation process. *See Abstr.* 886

536.423.1 : 539.155.2

990. Second-order transformations in two-component systems. Application to solutions of He^3 in He^4. STOUT, J. W. *Phys. Rev.*, **74**, 605–9 (*Sept.* 1, 1948).—A thermodynamic treatment is given. In addition to the requirement that there be no heat of transformation and no volume change, it turns out that the composition is equal in the two phases. Equations have been developed for $(dT/dx)_P$, $(dx/dP)_T$ and $(dP/dT)_x$ along the equilibrium curves. If we assume that the transformation of liquid helium remains second-order on the addition of a mole fraction x of He^3 to a He^4 solution, then for the limit of very dilute solutions $(dT/dx)_P = 21$ deg. and $(dx/dP)_T = 6 \times 10^{-4}$ atmos.$^{-1}$. A.

536.46 : 533.15

991. Some combustion problems. PUSHKIN, V. S. *J. Tech. Phys., USSR*, **18**, 49–60 (*Jan.*, 1948) *In Russian.*—3 problems are considered, viz. combustion: (1) of a coal particle, (2) of a coal stratum from the surface inwards, and (3) of a coal wall in a channel. The first is a continuation of Predvoditelev's work [*J. Techn. Phys., USSR*, **10** (*No.* 16) (1940)] which gave an exact solution of the boundary problem for this special case; the present paper supplies the general solution. (2), not dealt with before, can be solved by use of this general solution. (3) is apparently unconnected with (1) and (2), but it can be shown that it may be linked up with (2) by regarding (2) as the limiting case of (3) for the height h of the channel becoming infinite. A.

536.48 : 536.252

992. Heat transfer in liquid helium II by internal convection. LONDON, F. AND ZILSEL, P. R. *Phys. Rev.*, **74**, 1148–56 (*Nov.*, 1948).—The heat transfer in liquid He II by internal convection is calculated on the basis of Tisza's two-fluid model. The following differential equation for the heat current density, $\mathbf{q}$, applies: curl curl $\mathbf{q} = -\Lambda \operatorname{grad} T$. Here T = temperature, $\Lambda = (\rho s)^2 T/\eta_n$ a numerical constant depending on T and p only (ρs = entropy density and η_n = the viscosity of the "normal" fluid). Comparison with the measurements of the heat transfer in very fine slits by Keesom and co-workers shows only partial agreement. It appears that the heat conductivity of He II in narrow slits, even in the limit of very small flow, cannot be described by the usual laminary flow solutions of hydrodynamics within the two-fluid model, even when introducing further assumptions such as viscous slip and an Ohm's law type resistance. A.

536.49 : 536.41 : 539.31

The thermal stresses in a body. *See Abstr.* 1196

536.52 : 621.383 : 621.317.39

993. Photoelectric pyrometer of rapid response. ROBERTS, M. H. *J. Sci. Instrum. Phys. Ind.*, **25**, 337–9 (*Oct.*, 1948).—H.f. induction heating applied to the hardening of high-speed steel tools requires accurate temp. control, but the usual types of pyrometer are unsuitable because of the rapidity of heating. A photo cell of the emission type is therefore used to measure the radiation from the hot steel, with an interrupter in the optical path to avoid the difficulties of amplifying d.c. Negative feedback in the amplifier gives constant sensitivity, and the output may be shown on an indicator or recorder in addition to operating a relay giving automatic control. Such pyrometers are simple and inexpensive to construct, and should be applicable to many other problems in view of their rapid response, high sensitivity, constancy and suitability for recording and control. A.

536.628.2

994. Calorimeter for the determination of the true heat capacity and latent heats at high temperatures. SOKOLOV, V. A. *J. Tech. Phys., USSR*, **18**, 813–22 (*June*, 1948) *In Russian.*—This adiabatic high-temperature calorimeter is intended for studying transformations of the second kind and phenomena near the fusion point. It is provided with automatic control of the adiabatic conditions and permits of determinations of heat capacities and latent heats of reaction with an accuracy of $\pm 0{\cdot}5\%$. A.

536.633.3

995. The effective "gamma" for isentropic expansions of real gases. IBERALL, A. S. *J. Appl. Phys.*, **19**, 997–9 (*Nov.*, 1948).—In an isentropic expansion of

a real gas, the relationship $pv^{\gamma} = C$ (γ, C constant) is not exact. A development is given for an accurate exponent α (the effective "gamma"), related to the ratio of specific heats which permits the use of the relationship $p_0v_0^{\alpha} = p_1v_1^{\alpha}$ for an isentropic expansion between any two pressures. The exponent may be computed from the initial conditions of the gas, the expansion ratio, equation of state data, and data on the variation of specific heat with temperature. A.

536.653 : 532.782

996. Heats of formation and some derived thermodynamic properties of NaCl–NaBr solid solutions. FINEMAN, M. A. AND WALLACE, W. E. *J. Amer. Chem. Soc.*, **70,** 4165–9 (*Dec.*, 1948).—The heats of formation at 25°c of NaCl–NaBr solid solutions have been measured at intervals of 10 mol. %. A cubic equation has been fitted to these data by the method of least squares. Equations are given from which the partial molal heat contents relative to the pure solids can be calculated. By assuming the entropy of formation is that of random mixing, the free energies of formation were obtained. The limits of solubility have been determined graphically by the method of common tangents from 0 to 350°K. The critical solution temperature and concentration have also been calculated. With these data the solid solubility diagram has been constructed. A comparison of the heats of solution as obtained in this research with those calculated by Tobolsky [Abstr. 1932 (1942)] has been made. The differences noted have been discussed in terms of possible inadequacies in Tobolsky's development. A.

536.655

997. Latent heat of vaporization. CHU, J. C., DMYTRYSZYN, M., MODER, J. J. AND OVERBECK, R. L. *Industr. Engng Chem.*, **41,** 131–5 (*Jan.*, 1949).—From Kistyakovskii's equation for the heat of vaporization at the normal boiling point, a series of equations expressing the heat of vaporization for various classes of compounds in terms of the normal b.p. and parachor is derived. For paraffin hydrocarbons, the equation is developed further to correlate the heat of vaporization with the structural formula. Based on this derived equation, a nomograph is developed, from which the latent heat of vaporization can be readily predicted from the number of carbon atoms, the polarity number and the path number, all of which can be determined from the structural formula of the compound. 73 paraffins have been tested. The maximum error is of the order of less than ±5%, with an average error within ±2%. A second nomograph, based on the same equation, but empirically corrected for the deviation from the literature values, is also presented with the average deviation within experimental error. A.

536.66

998. Heat of formation of carbonyl fluoride. VON WARTENBERG, H. *Nachr. Wiss. Göttingen* (*No.* 1) 55–6 (1946) *In German.*—The heat of the reaction $COF_2 + 4KOH = 2KF + K_2CO_3 + 2H_2O$ is 95 ± 1 kg.-cal. Using known values for other reactions the following heats of formation at const. pressure are obtained: $F_2 + C_{diamond} + \frac{1}{2}O_2 = COF_2 +$ 142 ± 1 kg.-cal.; $F_2 + CO = COF_2 + 115$ kg.-cal. B. A.

536.6

999. Heat of formation of carbon tetrafluorid VON WARTENBERG, H. *Nachr. Wiss. Göttingen* (*No.* 1 57–8 (1946) *In German.*—The heat of the reactio $4K + CF_4 = C_{graphite} + 4KF$ is found to b 307 ± 3 kg.-cal., giving 231 ± 3 kg.-cal. for the hea of the reaction $C_{graphite} + 2F_2 = CF_4$. This valu is unexpectedly large. B. A

536.6

1000. Heat of formation of chlorine monofluorid WICKE, E. *Nachr. Wiss. Göttingen* (*No.* 1) 89–9 (1946) *In German.*—The heat of formation of Cl has been redetermined, the value obtained bein 1·6 ± 0·4 kg.-cal. In spite of this low value th dissociation temp. is very high. At 1 000° the degre of dissociation is 1%. The max. temp. of a Cl_2–F flame calculated for stoichiometric proportions of th gases at atm. pressure is 1 300°. By using the ne value for the heat of formation of ClF, the atomi heats of formation of the halogeno and hydroge halides are calculated. B. A

THERMODYNAMICS 536.7/.8

536.7

1001. Equation of state. Generalized correlatio applicable to all phases. RUSH, W. F. AND GAMSON B. W. *Industr. Engng Chem.*, **41,** 78–81 (*Jan* 1949).—In problems relating to vapour-liqui equilibria and the thermodynamic properties c materials, an equation of state applicable to liquid vapour and uniform phase has long been desired Such an expression was developed by McLeo [Abstr. 148 (1945)]. This paper presents a correlatio which permits the evaluation of the constants of th McLeod equation with only a knowledge of th critical constants of the substance. The results ma be extended to mixtures. Good agreement result with experimental values. A

536.71 : 533.7

An equation of state taking account of the critica coefficient. *See Abstr.* 901

536.77 : 533.7 : 531.1

1002. Generalized virial theorems. EINBINDER, H *Phys. Rev.*, **74,** 803–5 (*Oct.* 1, 1948).—The viria theorem of Milne is extended to include frictiona forces which are functions of position and time, whil that of Fock and Krutov is given a much simple derivation and is made to include non-conservativ systems. The relation between PV and the moment of E, E_r, and v is derived for a general ideal relativisti gas. Finally, a proof of the mathematical equivalenc between the kinetic and statistical methods of derivin the virial theorem is given. A

536.77

1003. Enpony and enchresy. ÖLANDER, A. Lette in *Science*, **108,** 566 (*Nov.* 19, 1948).—Suggestion t rename Helmholtz free energy "enpony" and th thermodynamic potential or Gibbs's function (Gilbe Lewis's free energy), "enchresy."

ELECTRICITY 537

THEORY . ELECTRONS 537.1

537.112 : 538.1

1004. On the possibility of observing directly the magnetic moment of a particle with spin. DE BROGLIE, L. *C.R. Acad. Sci., Paris*, **226**, 1765–7 (*May* 31, 1948) *In French.*—In the approximation of geometrical optics it is not possible to observe the magnetic moment of the electron either for theoretical reasons at speeds $\ll c$, or for practical reasons for speeds $\sim c$. These arguments are not conclusive for a fast particle of small mass. G. J. K.

537.12 : 537.132 : 539.166

1005. The moment of a 2-photon system. LANDAU, L. D. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 2) 207–9 (1948) *In Russian.*—The question of the annihilation of slow positrons and electrons is considered. I. Pomeranchuk [Abstr. 1007 (1949)] found that in the limiting case of immobile particles the probability of pair annihilation vanishes for parallel spins of the electron and positron. The question arises whether this be the result of a general strict selection rule limiting the possible values of the moment of momentum of a photon-pair system with zero sum of impulses; such a rule could be a consequence of specific properties of the photons connected with the transversality of the electromagnetic waves. The results of the investigation, applied to positron annihilation, lead to the conclusion that the usual 2-photon annihilation is rigorously forbidden in all states with odd orbital and total moments as well as states with total moment equal to unity. B. F. K.

537.12 : 537.132 : 539.166

1006. 3-photon annihilation of electrons and positrons. LIFSHITS, E. M. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 2) 211–12 (1948) *In Russian.*—[See Abstr. 1005, 1007 (1949)]. The problem considered is the approximate calculation on the theory of excitation of the effective cross-section of the 3-photon annihilation of an electron and positron with parallel spins in the limiting case of vanishing impact velocity. Only the results of the fairly involved calculations are given. They may be applied to calculating the life of positronium (hydrogen-type system of positron and electron) in the normal *s*-state in the orthopositron condition (11 spins). The 2-quantic annihilation of such a system being excluded [Abstr. 1005 (1949)], this prohibition proves to be rigorous and not connected with any approximations used in the determination of its probability; the same applies to the Coulomb effects due to the movement of the particles of the positronium. Owing to the comparative slowness of the particle movement in Bohr orbits, the calculation of the probability of annihilation may be based on the assumption of immobile particles. The life of ortho-positronium is found to be $8{\cdot}8\times10^{-8}$ sec, i.e. $\sim700\times$ that of the para-positronium (total spin = 0), determined from 2-photon annihilation. B. F. K.

537.12 : 537.132 : 539.166

1007. Selection rules in electron and positron annihilation. POMERANCHUK, I. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 2) 213–15 (1948) *In Russian.*—The investigation is based on Dirac's treatment of the problem [Abstr. 3939 (1930)] in which an average value for the effective cross-section is given, the averaging referring to the relative orientation of the electron and positron spins. An investigation without averaging discloses that for $\parallel$ orientation of the two spins when, in addition, the total mechanical moment of the spins = 1, the cross-section of 2-quantum annihilation $\to 0$ as the relative electron-positron velocity $\to 0$. This proposition is proved by the author. Reference is made to Landau's general theorem [Abstr. 1005 (1949)] according to which two oppositely directed quanta cannot be in a state such that their moment of momentum = 1. This excludes 2-quantic annihilation when the total electron-positron moment is equal to unity (even for relative velocity $\neq 0$). This has important bearings on the properties of the positronium atom, where a positron takes the place of the nucleus. Such an atom will have a finite lifetime owing to the annihilation. Practically, annihilation is possible only in the *S*-states of the positronium, as in other states the probability of the electron coming near the positron is exceedingly small. In the *S*-states the moment of the system coincides with the spin moment, and if this = 0 (para-positronium), 2-quantum annihilation becomes possible. For spin moment = 1 (ortho-positronium) 2-quantum annihilation is strictly prohibited, whilst 3-quantum annihilation is possible, although its probability is several $100\times$ smaller than that of 2-quantum annihilation. [See also Abstr. 1006 (1949)]. B. F. K.

537.12 : 539.153

1008. Classical radius of the electron and displacement of the 2 *S*-level of the hydrogen atom. CALDIROLA, P. *C.R. Acad. Sci., Paris*, **226**, 1349–51 (*April* 26, 1948) *In French.*—If on a classical picture the radius r_0 of a sphere of magnetic moment μ_0 and of total energy $\simeq$ the rest energy of the electron is calculated, this turns out $\simeq 14\times$ the usual "classical radius of the electron." By assuming that for distances between proton and electron $< r_0$ the field ceases to be a Coulomb one, the displacement of the $2S_{\frac{1}{2}}$-level of H may be explained. Thus this phenomenological theory does not substantially differ from Bethe's theory explaining the effect as due to the interation between the electron and the radiation field. L. P.

537.13

1009. Single scattering and annihilation of rapid positrons. BOTHE, W. AND HO, Z.-W. *Nachr. Wiss. Göttingen* (*No.* 1) 59–61 (1946) *In German.*—The collisions between positrons and electrons from Mn^{52} have been investigated by means of cloud-chamber experiments. For all collisions the energy and impulse law holds. The statistics of the relative energy-loss of the positron are considered. Calculated and observed frequency-distributions are in satisfactory agreement. The annihilation of the positron is theoretically rare. Three cases of it were noted with particles of energies 92, 245 and 352 keV, respectively. Collisions between positrons and nuclei resulting in considerable deflection are considered. Relatively large energy-losses result, a

possible explanation being the formation of a neutrino-pair. B. A.

ELECTROSTATICS . DIELECTRICS 537.2

537.212/.214 : 517.918

1010. Application of singular integral equations to the problem of the distribution of charge on thin non-closed surfaces. LEBEDEV, N. N. *J. Tech. Phys., USSR*, **18**, 775–84 (*June*, 1948) *In Russian.*—It is shown that the solution of the electrostatic problem of a disciform conductor, of conductors having the shape of thin spherical segments or of planes of circular cross-section leads to the consideration of a singular integral equation. The solution of this integral equation is given and, as special cases, the solutions of the above-mentioned problems are obtained. The method represents a non-ambiguous and direct approach to the problem considered, at the same time reducing the amount of calculation required. A.

537.214 : 537.311

1011. The loss of change of a sphere in still and in moving air. VON SCHWEIDLER, E. *S.B. Akad. Wiss. Wien*, **150**, *Abt. IIa* (*No.* 3) 209–19 (1941); **151**, *Abt. IIa* (*Nos* 1–3) 1–12 (1942) *In German.*—A conducting sphere is considered in a uniformly ionized gas with equal +ve and −ve ion mobility and true conductivity Λ. The apparent conductivity Λ^* is the equivalent conductivity in a medium obeying Ohm's law which would give an identical sphere potential at the same constant current. Part I determines the space charge distribution, potential and ratio Λ^*/Λ for still air. Contrary to previous theories this may lie between 0·412 and 1. Part II deals with moving air conditions; $\Lambda^* = \Lambda/2$ is found to hold (with 1% accuracy) down to velocities as small as 2 cm/sec. V. W. R.

537.226 : 548.0

1012. The dielectric constant and its dependence on temperature for crystals of the type of rutile and perovskite. SKANAVI, G. I. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 2) 231–4 (1948) *In Russian.*—An approximate expression for the dielectric constant ε of rutile is $\frac{\varepsilon - 1}{\varepsilon + 2} \simeq \frac{4\pi n}{3} \frac{\alpha_1 + 2\alpha_2 + \alpha_i}{1 - \alpha_2 c_{22} - \alpha_i c_{21}}$, where n is no. of molecules/unit vol., α_1 is the electronic polarizability of the Ti ion, α_2 of the O ion. The structure factors $c_{22} = -12 \cdot 1/a^3$ and $c_{21} = +18 \cdot 1/a^3$ (a = side of the square base of the elementary cell). α_i is the ionic polarization, ascribed to the Ti ion, and this factor accounts for the high values of ε below infrared frequencies. If $\alpha_i = 1 \times 10^{-24}$ cm^3 then $\varepsilon = 173$. Differentiation shows ε to be a minimum with temperature when $d\alpha_i/dT = 3\beta/(c_{21} + \frac{4}{3}\pi n)$ (β = coeff. of linear expansion), and this expression agrees qualitatively with experiment. D. H. W.

537.226.1

1013. Use of a calibrated capacitor for precise measurements of permittivity of samples of benzenes. MOURADOFF-FOUQUET, L. *C.R. Acad. Sci., Paris*, **226**, 1970–1 (*June* 14, 1948) *In French.*—A description of a capacitor with concentric cylindrical electrodes, for precision measurements. ε is $2 \cdot 2828_9$ at 20°C, and decreases approximately linearly with temperature to $2 \cdot 2287_6$ at 50°C. E. R.

537.226.2 : 538.56.029.6

1014. The dielectric constant of several gases at a wave-length of 3·2 centimeters. CRAIN, C. M. *Phys. Rev.*, **74**, 691–3 (*Sept.* 15, 1948).—The dielectric constants at room temp. of dry air, H_2O, water vapour, C_2H_6O, C_2H_5Cl, $CHCl_3$ and acetone have been measured at 9 340 Mc/s using the beat frequency method. For water vapour measurements were made over the range 293–342°K. A.

537.226.2/.3 : 538.569.4

1015. Microwave absorption and molecular structure in liquids. I. Measurement in organic halides at 1·27 cm wavelength. HESTON, W. M. H., JR., HENNELLY, E. J. AND SMYTH, C. P. *J. Amer. Chem. Soc.*, **70**, 4093–7 (*Dec.*, 1948).—A method is described for the measurement of dielectric constant and loss of high loss liquids by means of the variation in the reflection coefficient of a uniform dielectric layer as the depth of the layer is varied. The experimental procedure for measurement at a wavelength of 1·27 cm, method of calculation and errors are discussed. A.

537.226.2/.3 : 538.569.4

1016. Microwave absorption and molecular structure in liquids. II. Measurement in organic halides at 3·22 cm wave length. LAQUEUR, H. L. AND SMYTH, C. P. *J. Amer. Chem. Soc.*, **70**, 4097–102 (*Dec.*, 1948).—An apparatus for the measurement at a wavelength of 3·22 cm of the dielectric constants and loss factors of high loss liquids is briefly described. A.

537.226.2/.3 : 538.569.4

1017. Microwave absorption and molecular structure in liquids. III. Dielectric relaxation and structure in organic halides. HENNELLY, E. J., HESTON, W. M. H., JR. AND SMYTH, C. P. *J. Amer. Chem. Soc.*, **70**, 4102–11 (*Dec.*, 1948).—The dielectric constants and loss factors of 27 liquid organic halides measured at 1·27 and 3·22 cm wavelength are used, together with viscosities, densities and refractive indices to study the accuracy of the Debye equations for dielectric behaviour and the empirical modification proposed by Cole and Cole. The loss factors are satisfactorily represented by the semi-circular arc plots of Cole and Cole, which are used to calculate values for the critical wavelength, the wavelength at which the loss factor has its maximum value, and the corresponding relaxation time. Of the 27 polar molecules having different sizes, shapes and rigidities, those which are approximately spherical in shape conform closely to the Debye theory of dielectric relaxation which assumes spherical molecules. A distribution of relaxation times is found for the unsymmetrical molecules, increasing with molecular asymmetry and decreasing with rising temperature. This distribution may arise from the existence of the longer molecules in a variety of shapes caused by twisting around the C–C bonds as well as from orientation of the molecular dipole by twisting around these bonds. Curves for critical wavelengths and for viscosities plotted against number of C atoms in the molecular chain and against temperature show close parallelism between

the processes of dielectric relaxation and viscous flow. The activation energies calculated for the two processes give further evidence of this similarity. A.

537.226.32

1018. High-voltage polarization in solid dielectrics. KSENDSOV, Y. M. *J. Tech. Phys., USSR*, **18**, 3–10 (*Jan.*, 1948) *In Russian.*—The potential distribution for equilibrium, considering the moving charges all of the same sign, may be found from the boundary conditions of the problem. These are based on the fact that the charges may freely pass from the dielectric into the electrode, while the reverse is impossible. The solution explains the phenomenon of h.v. polarization in calcite and potassium nitrate, and the vitrification process. A.

537.228 : 537.333

1019. Action of an electrostatic field on the surface of mercury. BERTEIN, F. *J. Phys. Radium* (*Sér.* 8) **9**, 60–5 (*Feb.*, 1948) *In French.*—[See Abstr. 225 (1949)]. It is shown theoretically that the rupture of an Hg surface, initially at rest, by an e.s. field can be due to two different causes: local minute non-uniformities in the surface when field <1 MV/cm, and small thermal oscillations when field >1 MV/cm. F. LL. J.

537.228.4

1020. A possibility of increasing the depth of modulation in the Kerr effect. TOLSTOY, N. A. AND FEOFILOV, P. P. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 2) 219–21 (1948) *In Russian.*—The usual method of measuring the Kerr-effect in a capacitor cell between crossed Nicols produces elliptically polarized light when the incident light is plane-polarized. The measurement is made either by a compensator placed between the Nicols, or an objective optical receiver (photocell or thermo-element) placed behind the analyser. In order to exclude parasitic light and other secondary influences, an alternating field is mostly used, thus the light effect to be measured has also an alternating character. Owing to the smallness of the effect in most liquids and all gases the polarization ellipse is very elongated. The observation by objective means is made even less accurate by the fact that for elliptically polarized light the indication is proportional to the square of the effect (δ always $\ll 1$). The authors show that this can be improved by placing a $\lambda/4$ plate between the Nicols, in the direction of the axis of the polarizer. This reconverts the elliptically polarized light into linearly polarized light, the indication then being $\propto \delta$ and $\propto I_0$ (intensity of the incident, linear polarized light). Practical tests with a photo-multiplier as receiver and c.r.o. as indicator have demonstrated the full success of this simple expedient. B. F. K.

537.24 : 541.182.3

1021. Growth of charged particles in clouds. KUNKEL, W. *J. Appl. Phys.*, **19**, 1053–5 (*Nov.*, 1948). —In order to calculate the average growth of a charged particle in a dust cloud caused by electrostatic attraction, the following assumptions were made: the particles obey Stokes' law of motion, their velocities are small so that their motion can be considered to be in constant equilibrium with the forces acting, and the forces are effective at short ranges only or the cloud density is small enough so that not more than two particles have to be considered interacting at a time. In addition to the Coulomb force, there will appear an attraction between particles resulting from induced dipoles, but it was found that in general the effect of this force can be neglected. Straightforward integration of the equation of relative motion of two charged dust particles yields their effective cross-section for aggregation from which in turn can be determined the rate of growth if the particle size and charge distribution in the cloud are known. Assuming a highly simplified distribution, one arrives at the result that aggregation is negligible if the cloud density is $<10^6$ particles/cm^3 or if the average charge of one sign is $\ll 1\,000$ electrons per particle. A.

ELECTRIC CONDUCTION . CURRENTS 537.3

537.311.31 : 537.583

1022. Note on the ionic conductivity of oxide-coated cathodes. WAGENER, S. *Proc. Phys. Soc., Lond.*, **61**, 521–5 (*Dec.*, 1948).—Ionic conductivity in an oxide-coated cathode is regarded as due to the mobility of oxygen ions. The magnitude of the conductivity can be derived from the phenomenon of current decay in a pulsed diode. Results are consistent with those obtained by other methods. Some consideration is given to the relation between ionic conductance and diffusion, and it is shown that the decay phenomenon results from the interaction of these phenomena in a thin layer on the outer surface of the coating. A.

537.311.33 : 537.533.8

1023. Theory of the photon and secondary electron emission of effective semiconducting emitters. DIKMAN, I. M. *J. Tech. Phys., USSR*, **18** (*No.* 11) 1426–42 (1948) *In Russian.*—The phenomena are considered as space effects, the emitter being regarded as an ionic lattice of a conductivity sufficient for the replacement of the emitted electrons. The problem is solved by the method of the kinetic equation. A.

537.311.33 : 621.314.632

1024. Theory of rectification of an insulating layer. FAN, H. Y. *Phys. Rev.*, **74**, 1505–13 (*Nov.* 15, 1948).—The rectification by a blocking layer of low inherent conductivity is examined. The potential distribution is determined by the space charge due to free, current-carrying charge instead of by that due to fixed charge. The difference between this case and that treated by previous theories is pointed out. The theory is applied to Cu_2O rectifiers. It agrees better with experiment than previous theories. Its applicability to other cases is discussed. A.

537.311.33 : 621.315.59

1025. Phthalocyanines as semiconductors. ELEY, D. D. Letter in *Nature, Lond.*, **162**, 819 (*Nov.* 20, 1948).—Crystals of phthalocyanine and copper phthalocyanine were examined in a "Hysil" cell between platinum electrodes. The resistance was measured by means of a "Megger." The results obtained at various temperatures were in agreement with the well-known expression $\rho = \rho_0 \exp(E/kT)$.

It is concluded from the reproducibility of the results that the conductivity of pure phthalocyanine is not due to impurity centres, so that the substance is probably an intrinsic semi-conductor. The conduction process is assumed to be electronic. The characteristics of both substances can be influenced by heat treatment in H_2. H. K. H.

537.312.5 : 535.14

1026. On the theory of the internal photoeffect on polarons and colour centres. DEIGEN, M. F. *J. Exp. Theor. Phys., USSR*, **18**, 818–24 (*Sept.*, 1948) *In Russian.*—The wave function of the continuous spectrum of the polaron is derived, and the relation between the probability of the photoeffect on polarons and the frequency of the radiation found, as well as the qualitative relation between these variables in the case of the *F*-centres. It is furthermore shown that the identification, by some authors, of the *F*-curves of absorption with the absorption curves corresponding to the electron transitions directly into the continuous spectrum is unwarranted. A.

537.312.62

1027. Unequivocal laws in the theory of superconduction. VON LAUE, M. *Nachr. Wiss. Göttingen* (*No.* 1) 86–8 (1946) *In German.*—Theoretical. B. A.

537.312.62

1028. Superconductivity of bismuth alloys. ALEKSEYEVSKI, N. *J. Exp. Theor. Phys., USSR*, **18**, 101–2 (*Jan.*, 1948) *In Russian.*—In view of the discovery of superconductivity in Bi_3Ni further alloys were investigated both magnetically and electrically. The following were found superconducting at the temperatures indicated: Bi_4Rh (2·75°K), Bi_2Rh (2·2°K) and Bi_3Ca (1·7°K). The following were not superconducting down to the temperatures indicated: SbCu, SbCo, SbNi, SbFe, Bi_2Pt (all to 1·8°K), CaSe, PbSe (to 1·7°K), Bi_2Cr, As_2Cu (to 1·57°K), Sb_3Fe (to 1·45°K). D. S.

537.312.62

1029. On the theory of superconductors. WIŚNIEWSKI, F. J. *C.R. Acad. Sci., Paris*, **226**, 1964–5 (*June* 14, 1948) *In French.*—From the Hamilton–Jacobi equation of an electron moving freely in a magnetic field H the relation curl $(m\,v) + (e/c)H = 0$ is derived, where v is the velocity of the electron. This is identical with one of the equations of superconductors of F. and H. London, and the author concludes that superconductivity will occur if the lattice vibrations are small enough not to impede free movement of electrons. The case of a frozen-in magnetic field which is possible for a free electron but does not occur in a superconductor is not however considered. Some thermodynamic considerations of the disturbing influence of a strong magnetic field are added. H. L.

537.312.62

1030. Erratum: the magnetic threshold curves of superconductors. DAUNT, J. G. *Phys. Rev.*, **74**, 985 (*Oct.* 15, 1948).—See Abstr. 2898 (1948).

537.312.62 : 530.145

1031. On the problem of the molecular theory of superconductivity. LONDON, F. *Phys. Rev.*, **74**, 562–73 (*Sept.*, 1948).—The electrodynamics and thermodynamics of the superconducting state entail quite definite consequences with regard to the stability character of the supercurrents. In contrast to a recent attempt of Heisenberg, superconductivity is characterized in the present paper not as a state of electronic lattice order in ordinary space, but rather as a kind of condensed state in momentum space which implies long-range order of the momentum vector $p = mv + (e/c)A$ in ordinary space as a consequence of the requirements of quantum kinematics. Indications are that it is most probably the exchange interaction associated with the Coulombian field which is responsible for this condensation in momentum space. Ferromagnetism and superconductivity thus would play the role of two opposite limiting cases of the same effect depending on whether the exchange interaction, competing with the zero-point energy, promotes parallel orientation of the electronic spins or co-ordination of the translational momentum in a state of vanishing total spin. A.

537.312.62.029.6 : 537.311.6

1032. The theory of the anomalous skin effect in metals. REUTER, G. E. H. AND SONDHEIMER, E. H. *Proc. Roy. Soc. A*, **195**, 336–64 (*Dec.*, 1948).—The problem of metallic conduction at high frequencies and low temperatures, recently discussed by Pippard, is reformulated using the general methods of the theory of metals, and exact solutions are obtained which are valid for all frequencies and temperatures. It is shown that, for large values of the free path of the conduction electrons, the electric field is propagated through the metal as a "surface wave" which differs considerably from the classical exponential solution. The temperature variation of the surface impedance in the microwave region is considered in detail. Pippard's simplified theory is shown to be qualitatively correct, and a quantitative discussion of his experimental results is given. The frequency variation of the surface impedance at low temperatures is also discussed, and it is shown that relaxation effects are negligible in the microwave region but become important in the infrared and eventually restore the validity of the classical theory. The theory predicts that, as the frequency is increased, the reflection coefficient of metals passes through a minimum in the far infrared. A.

537.312.67 : 669.018

1033. Electric resistance of the alloy Cu_3Pd in a transverse magnetic field and the further ordering of its atoms. KOMAR, A. AND PORTNYAGIN, I. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 3) 365–6 (1948) *In Russian.*—Cu_3Pd belongs to the ordered alloys. In the ordering process of the atoms of the phase components the electric resistance ρ of the alloy and its Hall constant R decrease sharply. This is due to changes in the electron spectrum of the lattice and in the conditions of interaction with the lattice ions. It thus should be expected that the relative variation of the resistance in a transverse magnetic field would change non-trivially (i.e. not $\propto 1/\rho^2$) as the ordering proceeds. The authors investigated $\Delta r_\perp/r$ for the ordered and disordered states of the alloy at room temperature and at the boiling point of N in fields of intensities up to 28 kilo-oersted. An approximate equilibrium condition of order was attained after 660 hr of gradual annealing from 500° to 250°C. In the ordered state the relation between $\Delta r_\perp/r$ and H was the norma

one; $\Delta r_\perp/r = c(H/\rho)^2$. It was found that c decreased with lowered degree of ordering. Experimental data indicate that the steps of proceeding order are roughly ∝ tempering temperature. The measurements at high magnetic intensities in the disordered state proved to be more difficult. Still, it was possible to estimate that $\Delta r_\perp/r$ in the ordered state is ~250× larger than in the state of disorder. B. F. K.

537.32 : 538.114

1034. Effect of reversible and irreversible changes of magnetization on the thermo-electric power of ferromagnetics. BOUCHARD, J. *C.R. Acad. Sci., Paris*, **226**, 1895–7 (*June* 7, 1948) *In French.*—Discusses variation of the thermoelectric power ΔE between magnetized and unmagnetized specimens of a ferromagnetic, for a fixed temp. difference, as a function of H. Correspondence between ΔE loops and hysteresis loops is noted and attention is drawn to distinction between variations of ΔE occurring in irreversible and reversible regions of magnetization. Effects of tension are also reported. N. F. A.

537.324

1035. Thermo-electric investigation of some processes occurring in alloys. I. MARGOLIN, J. M. *J. Tech. Phys., USSR*, **18**, 61–70 (*Jan.*, 1948) *In Russian.*—The changes of the thermo e.m.f. were investigated for various carbon-steels and alloy steels after varied heat treatments, annealing and tempering. Some erroneous conclusions about the hysteresis of the thermo-e.m.f. drawn by Bakhmetiov (1897) were refuted. Relations between hysteresis and the thermal transformations are plotted for the individual materials investigated. The complex nature of the processes taking place, e.g. during the cooling down of a particular steel from 720 to 120°, is well brought out by the graph of the e.m.f. Numerical differentiation of the original curves enables accurate values of the singular points of these processes to be found, which may then be reproduced by automatic recording of the e.m.f., this being only one example of the usefulness of the method. B. F. K.

537.36

1036. Migration of palladium ions into sodium chloride. PARFIANOVICH, I. A. *J. Exp. Theor. Phys., USSR*, **18**, 790–4 (*Sept.*, 1948) *In Russian.*—Apart from the possibility of Pd ions penetrating into NaCl, the conditions of transition of Pd from the ionic into the colloidal state are considered. Some optical properties of crystals with Pd in the ionic and colloidal state are discussed. A.

ELECTRIC DISCHARGES 537.52

537.52 : 537.568

1037. Coefficient of recombination of ions under conditions of corona discharge in atmospheric air. POPKOV, V. I. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 1) 61–4 (1948) *In Russian.*—The well-known data for the recombination coefficients of ions in air have been obtained from measurements using ions generated in ionization chambers by α- or X-rays; the recombination time is of the order of 0·1 sec. For shorter times such measurements become difficult. In the case of corona discharge, particularly in electric fields of high potential gradient, the time may be very short. For bipolar corona there are two streams of ions of opposite signs, and the times of recombination near the two electrodes are not the same. This difference is investigated theoretically from considerations of the electric field and is confirmed by experiments on the discharge from two parallel wires. [See also Abstr. 235 (1949)]. B. H.

537.521.7 : 537.542.22

1038. A theory of the production of electrode vapor jets by sparks and arcs. FINKELNBURG, W. *Phys. Rev.*, **74**, 1475–7 (*Nov.* 15, 1948).—A thermal theory of the production of electrode vapour jets by arcs and sparks is presented which accounts satisfactorily for all known experimental results on vapour jets. The computed jet velocities are in excellent agreement with those measured for Hg sparks by Haynes and for the high current C arc by the author and co-workers. Theoretical predictions concerning the dependence of vapour jet production on the electrode materials provide a possibility for further checks of the theory. A.

537.523

1039. The initiation of long electrical discharges. II. Charging currents. BRUCE, C. E. R. *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref. L/T*180) 18 *pp.* (1948).—A continuation of the work of Abstr. 1148 (1945). It shows the application of the ideas therein developed, to the long laboratory spark. It is concluded that: (1) There is considerable evidence indicating that glow to arc transition occurs in the leader stroke of the long spark discharge, and that, just as in the case of the lightning discharge, the occurrence of this transition may represent the onset of instability. (2) The currents required to charge the channel of the discharge as it is formed are adequate to initiate this transition. (3) The difference between the phenomena in positive and negative streamers indicates that conditions of instability governing the transition are reached initially in the discharge channel itself, and that the need for a cathode spot delays the transition in streamers from the negative electrode. (4) The difference in velocity of positive and negative streamers may account for the pronounced difference in spark-over voltage when the polarity of the high voltage point is changed in point-plane breakdown. (5) Study of conditions of spark-over in hydrogen may lead to the elucidation of the breakdown process. (6) The study of astrophysical phenomena may also throw light on the characteristics of terrestrial electrical discharges. A.

537.523.3

1040. Recent developments in analysis of the mechanisms of positive and negative coronas in air. LOEB, L. B. *J. Appl. Phys.*, **19**, 882–97 (*Oct.*, 1948).—The mechanism of the negative Trichel pulses in air at atmos. pressure is re-analysed in the light of recent data [Abstr. 2847–8 (1948)]. The building up of an intense positive space charge, providing an auto-accelerative ionizing mechanism, and the choking-off by neg. ion formation are outlined, also the effect of these and other factors on pulse duration and frequency. The differences in pos. and neg. corona

currents are investigated, and the character of the pos. corona mechanism analysed on the same basis as the neg. The pos. point removes electrons quite effectively, leaving a field distorted by one sign of space charge only, and thus less complicated; the volume sensitive to triggering electrons is much larger. The observed near equality of pos. and neg. pulse thresholds is shown to be fortuitous. A.

537.523.3 : 621.3.015.532

1041. Determination of corona starting voltages for nonuniform fields in air. HUTTON, J. G. *Trans. Amer. Inst. Elect. Engrs*, **66**, 1674–80 (1947).—Abstr. 282 B (1949).

537.523.3 : 621.3.015.532

1042. The space charge due to corona. SMITH, O. J. M. *Elect. Engng, N.Y.*, **67**, 979 (*Oct.*, 1948).—Abstr. 283 B (1949).

537.523.5 : 537.542.2 : 621.385.18

1043. Current density of the arc cathode spot. COBINE, J. D. AND GALLAGHER, C. J. *Phys. Rev.*, **74**, 1524–30 (*Nov.* 15, 1948).—New measurements of the area of the arc cathode spot from measurements of width of tracks left on metals by a cathode spot moving in a magnetic field indicate that the c.d. is greater than values given by previous workers. At 2·6 A the following values are found in air at atmospheric pressure: Cu 124 kA/cm², Al 29·5 kA/cm², W 74 kA/cm², Hg on Cu 20·7 kA/cm². The Cu, Al and W electrodes were first oxidized in a bunsen flame. For an arc burning in Hg vapour with a Hg cathode at a few μ pressure, a c.d. of 50–220 kA/cm² at 2·6 A is found. Values at currents above 5 A could not be obtained because of the formation of multiple spots. A.

537.523.9

1044. Characteristics of the positive discharge column in gas mixtures. ZAITSEV, A. A. *J. Tech. Phys., USSR*, **18**, 949–54 (*July*, 1948) *In Russian.*—The voltage-current characteristics of the positive column were studied in pure Ne and A, in Ne with small admixtures of A, and in Ne and A with Hg vapour admixed. In pure Ne at a pressure of 9 and 11 mm Hg, the potential gradient has a max. for ~ 4 mA/cm² current density. In a mixture of Ne + 0·03% A the maximum potential gradient (p.g.) was observed throughout the whole pressure interval investigated. Thus a strong influence of admixtures exists at low current densities which, however, decreases when the current density is increased. In Ne + 0·1% A there is an interval in which the p.g. remains constant. For equal conditions of pressure, current density and equal diameter of the discharge tube, the p.g. may remain greater in A than in Ne, just as it may in pure A exceed the comparable value in a Ne–A mixture. A.

537.525 : 621.314.653

1045. The time-lag in starting a low-pressure arc on a mercury or gallium cathode in connection with field emission and surface deformation. WARMOLTZ, N. *Philips Res. Rep.*, **2**, 426–41 (*Dec.*, 1947).—At low pressures an arc is struck by suddenly applying a voltage of several kV between a Hg or Ga surface as cathode and a tungsten anode a short distance above it. The min. field strength at the cathode required to start a discharge is ~ 50 kV/cm, which is too low to produce appreciable field emission of electrons; hence the discharge cannot be initiated directly by field emission. Oscillography shows the existence of a marked time-lag in starting the arc which decreases rapidly with increasing field at the cathode. At field strengths > 250 kV/cm no macroscopic movement of the surface could be observed. In this region the time-lag corresponds to the time in which a microscopic disturbance on a liquid surface is drawn out into a sharp peak by the electric field, if we assume that the height of the initial hump is of the order of 10^{-8} cm. It is assumed that the discharge is initiated owing to a microscopic deformation of the surface which continues until the electric field at its peak has increased to such a value as to produce an appreciable field emission of electrons. This emission current rapidly develops into an arc-discharge, a process that may be promoted by an enhanced evaporation of Hg from the peak of the deformation. At field strengths < 250 kV/cm a directly observable macroscopic movement of the mercury surface precedes the mechanism described above and thereby lengthens the time-lag. A clean anode surface proved to be essential. The phenomena observed at extremely low pressures with a Ga cathode were essentially the same as those with Hg. A.

537.525.72 : 621.385.18

1046. Energy absorption by negative ions. IONESCU, T. V. *C.R. Acad. Sci., Paris*, **226**, 1005–7 (*March* 22, 1948) *In French.*—Discusses the motion of H_2^- ions in a small h.f. field superimposed on a steady d.c. field, and shows that they behave as circuits having calculable values of inductance and resistance at frequencies corresponding to the sum or difference of field and precession frequencies. [See Abstr. 1009–10 (1948)]. N. F. A.

537.525.4 : 621.3.015.54

1047. The excitation and transport of metal vapour in short sparks in air. WILLIAMS, G. C., CRAGGS, J. D. AND HOPWOOD, W. *Proc. Phys. Soc., Lond., B*, **62**, 49–61 (*Jan.*, 1949).—A study of the excitation temperature in certain spark discharges of accurately known current characteristics. The excitation temperatures are found by measuring intensity ratios for certain spectral lines where the relevant transition probabilities are known, and are comparable with earlier work by Ornstein and his collaborators on arc discharges. They are higher than those generally found for arc conditions. Certain peculiarities relating to the evaporation of electrode metal are described. In particular the presence of discontinuous evaporation was noticed, and it was found that different electrode metals showed considerable variations in their behaviour in this respect. A.

537.525.72

1048. Erratum: Theory of high frequency discharges. IV. MARGENAU, H. Letter in *Phys. Rev.*, **74**, 706 (*Sept.* 15, 1948).—See Abstr. 1251 (1948).

537.525.8

1049. Experimental researches on high-frequency discharges. CHENOT, M. *Ann. Phys., Paris* (*Sér.* 12) **3**, 277–375 (*May–June*, 1948) *In French.*—A comprehensive description of a research on the properties of

h.f. gaseous discharges in hydrogen, oxygen and air ($\lambda = 34$–250 m). The discharge tubes were a few cm in dia. and had lengths of 5–20 cm. The press. range was 0–1·5 mm Hg, and breakdown voltages ranged up to about 1 000 V. Sections of the work are on (1) general discussion of "electrodeless" discharges; (2) theoretical discussions of such topics as plasma oscillations, and the propagation of electrical disturbances in discharges; (3) the properties of h.f. discharges in tubes with electrodes; (4) the determination of breakdown voltages for the range of parameters given above; (5) the luminous characteristics of the discharges; and (6) a study of certain discontinuities in the breakdown voltage characteristics. J. D. C.

537.528

1050. Current and voltage in a short concentrated arc discharge. Sobolev, N. *J. Tech. Phys., USSR*, **18**, 753–6 (*June*, 1948) *In Russian.*—Results are given of an oscillographic investigation of the current and voltage in a short capacitor arc discharge employing a battery of capacitors of 25 to 275 μF discharging across a 3 mm needle-plate gap in transformer oil. The oscillograms were taken using three standard resistances of 0·017 Ω, 0·05 Ω and 0·10 Ω, with currents up to 3 700 A at 250 V. E. R. A.

537.528

1051. Velocity of the anode spark in copper sulfate solutions under application of impulsive potential. Henry, H. F. *J. Appl. Phys.*, **19**, 988–94 (*Nov.*, 1948).—The velocity of the luminous anode spark produced in $CuSO_4$ solutions by application of impulsive potential has been measured as a function of the interelectrode gap, input voltage and solution normality. Determinations were made for input potentials of 15–30 kV, interelectrode gaps of 15–80 mm, and solution concentrations of 0·0125–0·0625 N. The spark velocity was found to depend upon the input potential and the interelectrode gap by the empirical equation $V = 311\cdot1(E_0 - 11\cdot7)/G$ (V = spark velocity in m/sec, E_0 = input voltage in kV and G = interelectrode gap in cm). Qualitatively, it was observed that as the solution strength increased, the maximum breakdown distance decreased and the spark behaved more erratically. The maximum length which the spark streamers reach may be stated empirically by the equation $L_m = 2\cdot33\times10^{-3}(E_0 + 2\cdot89)^2/(N + 0\cdot545)(G - 0\cdot43)^{\frac{1}{2}}$ (L = max. streamer length in cm, N = normality of the solution). The computed potential at which the spark ceases its progress through the liquid, E_m, $\propto$ the input potential but was independent of the interelectrode gap and the solution concentration. The ratio E_m/E_0 was 0·646. The time lag in initiation of the spark was also found to depend upon the input voltage but to be independent of the interelectrode gap and the solution concentration. A.

X-RAYS 537.531

537.531 : 535.31

1052. Geometry and crystal physics of an X-ray lens for monochromatic radiation. Hoppe, W. and Trurnit, H. J. *Z. Naturforsch.*, **2a**, 608–15 (*Nov.–Dec.*, 1947). Also *Nachr. Wiss. Göttingen* (*No.* 1) 29–32 (1946) *In German.*—A theoretical discussion of the formation of images by "lenses" consisting of doubly curved crystal sheets or of solids with suitably varying lattice spacings. The former can be realized by depositing oriented monomolecular films of, for example, fatty acids, on suitably formed surfaces, such as the interior of a segment of a sphere. (Bending a crystal as in a monochromator can produce only "developable" surfaces.) For small apertures the positions of the object and the image are connected by the lens law, and for spherical lenses the only geometrical aberration is curvature of the field. Non-spherical surfaces introduce astigmatism and other errors. Chromatic aberration is large, and the finite breadth of X-ray lines sets a limit of $\sim 1\,\mu$ to the resolving power of an X-ray microscope. A solid lens would give a great increase in the brilliancy of the image. A. J. C. W.

537.531 : 535.33

1053. Geometrical factors affecting the contours of X-ray spectrometer maxima. I. Factors causing asymmetry. Alexander, L. *J. Appl. Phys.*, **19**, 1068–71 (*Nov.*, 1948).—The observed asymmetry of X-ray spectrometer maxima arises principally from three-dimensional properties of the ideally two-dimensional focusing arrangement employed, vertical divergence of the primary beam being the fundamental cause. A mathematical formula is developed that expresses the degree of asymmetry as a function of the reflection angle and the geometrical properties of the apparatus. The asymmetrical effects predicted in this way are qualitatively confirmed with experimental measurements. Practical suggestions are made for minimizing asymmetry. A.

537.531 : 535.34

1054. The absorption of incident quanta by atoms as defined by the mass photoelectric absorption coefficient and the mass scattering coefficient. Victoreen, J. A. *J. Appl. Phys.*, **19**, 855–60 (*Sept.*, 1948).—Evidence presented indicates that the absorption of quanta as defined by the mass photoelectric absorption coefficient τ/ρ and the mass scattering coefficient σ/ρ of any element may be represented by a simple expression. Tabulated values of the calculated mass absorption coefficients μ/ρ are given for wavelengths from 0·01 to 40 Å for H and C and from 0·01 Å to λ_K and λ_K to λ_L for Al, Cu, Sn and Pb. Graphs are given showing agreement with observed values. A.

537.531 : 537.546.4

1055. Thick-target X-ray production in the range from 1 250 to 2 350 kilovolts. Buechner, W. W., Van de Graaff, R. J., Burrill, E. A. and Sperduto, A. *Phys. Rev.*, **74**, 1348–52 (*Nov.* 15, 1948).—An experimental investigation has been made of the thick-target production of X-rays by electrons from an electrostatic accelerator. Measurements were made with an ionization chamber for targets of Be, Al, Cu, Ag, W and Au. Various voltages from 1 250 to 2 350 kV were used, and the angular range covered was from 0 to 140°. The total radiation intensity, integrated over all angles, is found to be accurately linear with atomic number in this energy range. From these measurements, the efficiency of X-ray production has been calculated. For the case of

2·35 MV electrons on Au, a value of 7·4% is obtained. This is in adequate agreement with theoretical predictions. A.

537.531 : 539.164

Action of ionizing radiations on ethyl iodide. *See Abstr.* 1142

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533 : 539.18

1056. Emission of secondary electrons from nickel and molybdenum by neutral atoms of mercury and potassium. CHAUDHRI, R. M. AND KHAN, A. W. *Proc. Phys. Soc., Lond.*, **61**, 526–31 (*Dec.*, 1948).—The Hg particles were produced by neutralizing a homogeneous beam of accelerated ions from a hot-cathode Hg arc on the walls of a narrow Ni canal which they strike at grazing incidence. The neutral atoms of K were produced by passing a beam of fast ions of definite velocities through vapours of K where they are neutralized by electron exchange with neutral K atoms. It is observed that the secondary emission rises with the number and the energy of the particles and that the energy distribution among the secondary electrons is always Maxwellian, suggesting that the emission is probably due to intense local heating. The effective temperatures of the target have been calculated in typical conditions. It is also shown that the targets scatter neutral atoms, dirty surfaces scatter more Hg atoms than clean ones, but the reverse is the case with K particles. A.

537.533.7

1057. Contribution to the theory of the Cherenkov effect. BECK, G. *Phys. Rev.*, **74**, 795–802 (*Oct.* 1, 1948).—The rigorous solution is given for the field of a uniformly moving point charge which, coming from vacuum, enters at $t = 0$ through a plane surface into an ideal, macroscopic, homogeneous dielectric medium ($\varepsilon = \text{const.}$). The solution represents a characteristic transition radiation, as the velocity of motion approaches $c/(\varepsilon)^{\frac{1}{2}}$ and furnishes information about the formation of the characteristic cone if $v > c/(\varepsilon)^{\frac{1}{2}}$. A.

537.533.71/.72 : 537.315 : 621.385.833

1058. The use of the electron mirror for depicting the variations of surface potential of metals and semi-conductors. ORTHUBER, R. *Z. angew. Phys.*, **1**, 79–89 (*March*, 1948) *In German.*—If a uniform electron beam falls on an electron mirror in which the potential varies across the surface, the reflected beam will exhibit variations in intensity. The bombarding beam is supplied by a conventional electron gun, deflected by a magnetic field and focused on the mirror by an electrostatic lens. The reflected beam is deflected in the opposite sense by the magnetic field and is allowed to fall on a fluorescent screen. If the potential of part of the mirror is below the mean potential, it is imaged as a dark area surrounded by a bright ring, and vice versa. The apparatus was tested on various prepared surfaces and then used to observe Ba-films on Ni and various semi-conductors. The picture obtained from the Ba-film gives a good agreement with that obtained by thermionic emission. Potential variations on semi-conductors were produced by focusing light pictures on them and the efficiency of the device as picture convertor studied. Heavy metal sulphides were sensitive to wavelengths up to 1·8 μ. A. H. W. B.

537.533.72

1059. Focusing field for a 180° type spectrograph. BEIDUK, F. M. AND KONOPINSKI, E. J. *Rev. Sci. Instrum.*, **19**, 594–8 (*Sept.*, 1948).—A magnetic field is derived to meet two requirements: it is to vary only with the distance from the central axis; it must focus perfectly the electrons emerging from a point source and confined in the median plane. The transmission and resolution of an instrument using such a field is then investigated. A.

537.533.72 : 531.31 : 621.385.8

1060. The refractive index in electron optics and the principles of dynamics. EHRENBERG, W. AND SIDAY, R. E. *Proc. Phys. Soc., Lond., B*, **62**, 8–21 (*Jan.*, 1949).—The origin of the refractive index in electron optics is discussed in some detail, and the uniqueness of an expression given is demonstrated. On this basis, some general properties of electron optics are investigated. A relation between ray direction and wave normal is obtained. Whereas the refractive index is unique in terms of the magnetic vector potential **A**, this itself is arbitrary to some extent. It is shown that **A** must, for purposes of electron optics, be chosen so as to satisfy Stokes' theorem and that, if it does, no observable effects result from the arbitrariness of **A**. An expression for the optical path difference is given in terms of the magnetic flux enclosed. The results are applied to a number of questions, viz. the differential equations for trajectories, the focusing properties of an axially symmetric field and the interference pattern produced by two converging bundles of rays which enclose a magnetic flux. A.

537.533.72 : 535.215 : 537.523.3/.5

1061. The second limiting case of electron optics. SPIVAK, G. V. AND LUTSKAYA, R. A. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 3) 375–8 (1948) *In Russian.*—The view that the field of phenomena usually collectively referred to as electron optics is confined to phenomena observed in vacuum conditions is untenable in the light of recent investigations. Although it is true that, e.g., in gas-focused electronic devices a pressure of a few $\frac{1}{100}$ mm is sufficient for the beam to be dispersed and eventually suppressed, at far higher pressures, viz. approaching atmospheric pressure, there is a return of conditions favourable to beam formation and production of qualitative images over distances ~10–15 cm. The electron orbit in the 1st case depends on the local values of electric and magnetic fields and, owing to the electron inertia, on the distribution of both scalar and vector potentials all along the path, whilst in the 2nd case, owing to the frequent collisions, the movement depends on direction and value of the forces E/p and H/p at any point, p being the pressure. The earlier experiments [Spivak and Kardash, *J. Phys., USSR*, **9**, 447 (1945); Abstr. 355 (1947)] were carried through with spark discharges and impulse corona. The images were distorted by Lichtenberg figures and parasitic sparks and became unrecognizable at distances of 0·5 cm. The authors experimented with brush discharges and

also with non-independent discharges on metal objects irradiated with ultraviolet. The latest experiments, with irradiation of the cathode by a carbon arc or Hg quartz lamp, again proved the possibility of obtaining images at 10–15 cm, and also of getting rid of Lichtenberg figures and other distorting influences. The experiments are described in detail and specimens of the images obtained are given. B. F. K.

537.533.72 : 535.417 : 621.385.833

1062. An interferometric method for the calibration of electron microscope magnification. FARRANT, J. L. AND HODGE, A. J. *J. Appl. Phys.*, **19**, 840–4 (*Sept.*, 1948).—Interferometric methods have been used to measure uniform cylindrical silica and glass fibres as small as 5 μ in dia. with better than 1% accuracy. Such fibres yield sharp images when examined in the electron microscope and constitute a convenient and robust specimen for accurate direct calibration of the instrument for magnifications up to 10 000 dia. Higher magnification ranges are then readily determined by means of an internal calibration obtained by taking micrographs of glass spheres about 0·5 μ in dia. Such spheres are also convenient specimens for determining the image distortions which must be known to correct the widths of the fibre images. This method appears more accurate than any employed hitherto. A.

537.533.72 : 621.385.83

1063. The spreading of an electron optical pencil under the influence of its own charge. WENDT, G. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 5–6) 256–64 (1948) *In German.*—Previous analyses have assumed either a parallel beam or one which converges to a geometric point. The present study considers the general case of a field-free space (except for the moving charges) and a constant charge density across the beam.

A. H. W. B.

537.533.72 : 621.385.833

1064. Atomic contrast in the electron microscope. BOERSCH, H. *Z. Naturforsch.*, **2a**, 615–33 (*Nov.–Dec.*, 1947) *In German.*—A number of suggestions are made for improving the contrast in electron microscopes so as to reveal individual atoms. These suggestions are based on the assumption that the resolution of the electron microscope can be improved to give a min. separation of 3 Å, and include the screening of inelastically scattered electrons, the use of phase contrast, and developments in dark-ground technique. J. T.

537.533.73

1065. Aids to analysis of patterns obtained in the diffraction of electrons by gases. YEARIAN, H. J. AND BARSS, W. M. *J. Appl. Phys.*, **19**, 700–4 (*Aug.*, 1948).—Three techniques have been found particularly useful: (1) Use of a continuously rotating shutter placed directly in front of the photographic plate used to record the patterns. The shutter has an angular opening $\propto$ (distance from the centre of the pattern)^3 and serves to reduce greatly the high background intensity gradient which is characteristic of electron scattering. (2) Application of a Fourier computing scheme to the transformation from intensity curves, derived from observed patterns, to the "radial distribution function," which is of value in selecting a model for the molecule whose structure is being determined by the analysis. (3) Computation of patterns corresponding to various molecular models by means of a graphical synthesizer in $(\sin x)/x$. Its advantages over the usual numerical computing schemes are that it takes account of the angular variation of atomic structure factor for electron scattering, and makes evident the contributions of scattering by specific atom pairs to the complete synthesized intensity curve. A.

537.533.73 : 548.74

1066. Electron interference at high potentials. MÖLLENSTEDT, G. *Nachr. Wiss. Göttingen* (*No.* 1) 83–5 (1946) *In German.*—Even for very thin Al preparations it is possible to obtain good interference diagrams with an electron beam of 600 kV energy, without using a very intense primary beam. Interference diagrams obtained with single crystals are not only clearer, but because of the decrease of dynamic interaction with the potential of the beam, they are simpler. The most important reflections of the interference pattern are strongly accentuated, whilst subsidiary reflections fade into the background. The dependence of the limiting thickness for interference on the potential of the electron beam is considered for Debye-Scherrer diagrams and for single crystals. For polycryst. Al the limiting thickness for 80 kV electrons is 0·2 μ, whilst for electrons of 400–600 kV it is 2 μ. Single crystals give even better results. At 500 kV a mica crystal 2·2 μ thick gives a definite Kikuchi diagram although the number of primary reflections is somewhat limited. Only for thicknesses of 10 μ is the diffusion so great as to render the diagram unsuitable for structural analysis. B. A.

537.533.74

1067. Investigation of the higher approx. of the non-stationary Dirac method in its application to the problem of fast electron scattering. URBAN, P. *S.B. Akad. Wiss. Wien.*, **151**, *Abt. IIa* (*Nos* 7–8) 201–24 (1942) *In German.*—Extending the investigation by F. Sauter [Abstr. 5052 (1933)] the author calculates higher approximations to the problem of scattering of fast electrons by nuclei, using the Dirac method. The third approximation consists of two terms which become divergent as the nucleus is approached. If the Schrödinger theory is considered the first term corresponds with the one found by Möller [Abstr. 1579 (1930)]. V. W. R.

537.533.74

1068. The higher approximations of the Born method in the Dirac theory. URBAN, P. *S.B. Akad. Wiss. Wien*, **151**, *Abt. IIa* (*Nos* 7–8) 225–47 (1942) *In German.*—The second approximation of the Born method of calculating the impact of fast electrons is calculated by the stationary Dirac theory. An improved formula for the intensity of scattering gives better agreement with experiments by H. V. Neher [Abstr. 1355 (1932)] using Al. V. W. R.

537.533.74

1069. Derivation of Mott's corrected scattering formula using hypercomplex units. URBAN, P. *S.B. Akad. Wiss. Wien.*, **151**, *Abt. IIa* (*Nos* 9–10) 315–21 (1942) *In German.*—Mott's formula for the scattering of fast electrons by light nuclei is deduced in corrected form directly from the Dirac equation using hyper-

complex units. The corrected formula shows better agreement with recent experimental results. V. W. R.

537.533.92 : 537.533.7

1070. The specific primary ionization and energy loss of fast electrons in matter. Hereford, F. L. *Phys. Rev.*, **74**, 574–9 (*Sept.* 1, 1948).—By utilizing the dependence of the efficiency of a Geiger–Müller counter upon the primary ionization of a counted particle, the primary ionization by electrons in H has been determined for energies in the range 0·2 MeV to 9·0 MeV. The relative stopping powers of C and H_2O have also been investigated, the results yielding evidence for the existence of a polarization effect which reduces the energy loss of fast particles in condensed matter. Experimental results are compared with those of the Bethe–Bloch theory and the Halpern–Hall theory which takes into account the polarization properties of the medium. A.

537.534 : 621.384

1071. An ion microscope with a transverse magnetic field. Sasaki, N. *J. Appl. Phys.*, **19**, 1050–3 (*Nov.*, 1948).—A brief discussion of electron and ion microscopes is presented and a low magnification, electrostatic ion microscope described. It is of the emission type in which the source of positive ions is imaged. If more than one species of ion is emitted, the images corresponding to the various atom weights may be separated by means of a transverse magnetic field and the ratio of atomic weights calculated from the displacements. The possible uses of such an instrument are pointed out. A.

537.534.74

1072. The scattering of 2·4- to 3·5-Mev protons by protons. Blair, J. M., Freier, G., Lampi, E. E., Sleator, W., Jr. and Williams, J. H. *Phys. Rev.*, **74**, 553–61 (*Sept.* 1, 1948).—Collimated monoenergetic protons, accelerated by the Minnesota electrostatic generator to energies of 2·42, 3·04, 3·27 and 3·53 MeV, were scattered by hydrogen gas and detected at well defined angles from 8° to 45°. The observations at each angle and energy have been reduced to values of the absolute cross-section for proton-proton scattering per unit solid angle. These cross-sections are considered to be reliable to ±1·6%. A.

537.534.74

1073. Inelastic scattering of protons from light nuclei. Fulbright, H. W. and Bush, R. R. *Phys. Rev.*, **74**, 1323–9 (*Nov.* 15, 1948).—A method has been developed for doing scattering experiments inside the vacuum chamber of an f.m. cyclotron. The magnetic field of the cyclotron is used to analyse the scattered beam. The spectrum of the scattered particles is recorded on photographic plates, and lines corresponding to states of the scattering nucleus are found. Levels are reported for B, C^{12}, N^{14}, O^{16}, Mg, Al^{27} and Ni. A.

DISCHARGE TUBES . COUNTERS 537.54

537.542

1074. The Geiger discharge. Wilkinson, D. H. *Phys. Rev.*, **74**, 1417–29 (*Nov.* 15, 1948).—It is pointed out that those phenomena concerned with Geiger counter operation which are well understood are those associated with the motion of the positive ion sheath while those awaiting explanation are associated with its development. A theory of this development is presented and used to calculate the following phenomena: (i) The relation between starting potential and counter variables; (ii) the amount of charge generated in the discharge; (iii) the shape of the plateau curve; (iv) the velocity of propagation of the discharge down the wire. Good agreement is obtained at all points. The curve connecting the charge generated and the overvolts is shown to consist of two parts, each a straight line, their slopes bearing a ratio of 2 : 1. The plateau curve is shown to climb more steeply to its constant value, the greater the number of electrons liberated in the counter by the ionizing particle, and the effect is confirmed experimentally. The velocity of propagation is shown to vary roughly linearly with overvolts but to tend to a finite value at zero overvolts. All forms of counter behaviour are shown to depend strongly on the ratio of charge generated in the counter to that originally on the wire. A.

537.542

1075. The influence of a transverse magnetic field on a cylindrical plasma. Beckman, L. *Proc. Phys. Soc., Lond.*, **61**, 515–20 (*Dec.*, 1948).—The conditions in a cylindrical plasma under the influence of a transverse homogeneous magnetic field are treated by known methods. It is shown that the magnetic field deflects the column towards the wall with the result that the total loss of electrons and ions is increased. This causes an increase in electron temperature and in the axial field strength. Formulae relating the axial electric field, the magnetic field and the electron temperature are derived as well as equations describing the electron density distribution. Some measurements have been made in order to test the theory. The agreement is fair, taking account of the limits of experimental accuracy and of uncertainty in the constants used in the calculations. A.

537.542

1076. Further experiments with an adjustable Geiger–Müller counter. Fenton, A. G. and Fuller, E. W. *Proc. Phys. Soc., Lond. A*, **62**, 32–40 (*Jan.*, 1949).—An adjustable Geiger–Müller counter and special electronic circuits have been used to study the effect of several counter variables on the occurrence of multiple pulses. The results show that the plateau characteristics combine the effects of an increase in efficiency and an increase in the probability of a multiple pulse as the operating potential is raised. It was found that the probability of occurrence of multiple pulses does not depend simply upon the charge per pulse, but also upon the anode diameter and the total pressure of the filling. Curves show the charge per pulse as a function of the operating potential. A change of slope occurs when the charge per pulse $\simeq$ the charge on the active portion of the anode. The counter was used as an ionization chamber at operating potentials below the Geiger region. It was found that as the potential is raised above the threshold of the proportional region the ionization current varies with potential as $\log I \propto V$ while at higher potentials the relation is adequately expressed

by $\log\log I \propto V$. Near the Geiger region a sharp break occurs in the log log curve, which is taken to indicate that the discharge begins to spread at this stage. A.

537.542 : 537.534

1077. On the production of ion beams by means of a high frequency discharge. NEUERT, H. *Z. Naturforsch.*, **3a**, 310–12 (*May*, 1948) *In German.*—In the arrangement previously used by Thonemann, 1946 [see Abstr. 2344 (1946), 363 (1947)] an increase in the ion current and energy can be obtained by applying a weak magnetic field throughout the discharge bulb: ion currents of 8 mA at 18 kV were obtained at suitable pressures. Analysis of ion beams by magnetic and electric deflection methods showed the ions to possess practically equal energies because the accelerating voltage was large compared with discharge voltage. The proportion of H_1^+ to H_2^+ could be increased from 33% at 8 kV to 50% at higher voltages. F. LL. J.

537.542 : 537.56

1078. Some experiments on photo-ionization in gases. JAFFE, A. A., CRAGGS, J. D. AND BALAKRISHNAN, C. *Proc. Phys. Soc., Lond. B*, **62**, 39–48 (*Jan.*, 1949).—An investigation of the discharge spread in Geiger counters filled with H, Ne, A, He, shows that in certain circumstances it is due almost entirely to photo-ionization in the gaseous counter filling. The results enable the absorption coefficients of the operative radiations to be found. A.

537.542 : 537.562

1079. Theory of the positive column in an annular discharge tube. PACHNER, J. *J. Appl. Phys.*, **19**, 1072–6 (*Nov.*, 1948).—The distribution of the electron and ion concentration and of the current density in an annular discharge tube are calculated on the basis of Schottky's diffusion theory of the positive column. A.

IONIZATION . THERMIONICS 537.56/.58

537.56

1080. Ionization measurements in helium and neon. ESCHNER, A. *S.B. Akad. Wiss. Wien.*, **150**, *Abt. IIa* (*No.* 8) 175–92 (1941) *In German.*—Positive ions may liberate electrons from a negative electrode where they are neutralized and give up their ionization energy. Experiments are described to determine whether this secondary effect may affect ionization measurements with gases of high ionization-potential like He and Ne. A special ionization chamber having a suppressor grid to screen the central electrode from secondary electrons was used. No secondary emission was observed with the gases used. V. W. R.

537.56

1081. Current fluctuations in an ionization chamber with finite collection period. BARIT, I. Y. AND PODGORETSKI, M. I. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 4) 563–6 (1948) *In Russian.*—The problem has been treated hitherto [Campbell, *Phys. Z.*, **11**, 826 (1910); Schiff and Evans, *Rev. Sci. Instrum.*, **7**, 456 (1936); van der Velden and Eudt, Abstr. 3004 (1942)] under the limiting assumptions of the collecting time being $\ll RC$ and of a uniform effect of all ionizing particles in the chamber. The theory given is free of these limitations, and based on principles partly due to Bunimovich [*J. Phys.*, **10**, 35 (1946)]. The ionization, given by a differential probability law based on an assumed charge distribution and its change in time, sets up "elementary" currents, the summation of which yields the total current. Dispersion has also to be considered. It is then shown how the fluctuations may be represented by "elementary impulses." As an example the case of the flat ionization chamber is treated, being the simplest one and yet showing all essential features of the problem. The solution shows that the relative fluctuation in the general case is smaller than that resulting for negligible collecting time, which is physically evident considering the effect of the ionization chamber as neutralization within a certain "effective" time $\simeq RC + T$ (T = collection time). The fluctuation obviously must decrease for increasing "effective" time. The cases of ionization mainly in the centre of the chamber, and throughout the chamber, are considered separately and, not surprisingly, lead to very different results. Eventually the author casts a passing glance on the problem of single-pulse observations in ionization chambers, the actuality of which in connection with cosmic ray studies is well known. B. F. K.

537.58 : 545.82

1082. Singularities in the light spectrum of oxide cathodes during thermionic emission. DEBIESSE, J. AND CHAMPEIX, R. *C.R. Acad. Sci., Paris*, **226**, 1517–18 (*May* 10, 1948) *In French.*—The spectrum from a heated cathode was examined before and during the emission of a current $\simeq 100$ mA/cm². During emission, lines due to doubly and singly ionized Ba and Sr were observed, as well as H lines. The latter were due to gas adsorbed on the electrodes during manufacture. A. H. W. B.

537.583

1083. Some physical properties of barium-oxide-coated cathodes. MORGULIS, N. D. AND YAGOVDIK, V. S. *Dokl. Akad. Nauk, URSS*, **59** (*No.* 2) 247–50 (1948) *In Russian.*—The potential distribution in the oxide layer (200 μ thick) of a cathode 1·25 mm dia. has been measured by means of internal probes. Voltage pulses of amplitude $\leqslant 1\,500$ V and duration 192 μsec. were applied to the anode (dia. 7 mm). The contact potential between the oxide layer and the core is generally a few volts, increasing to some tens of volts at low temperature and high current-density. At the surface of contact the field-strength is about 10^5 V/cm; elsewhere about 10^3 V/cm. At 1 120°K the concentration of free electrons is of the order of 10^{15} per cc. The internal and external work functions are respectively 0·8 and 0·9 eV. A. SCH.

COSMIC RAYS 537.591

537.591

1084. Probable example of a meson of mass 1 000 giving rise to a cosmic ray star. LEPRINCE-RINGUET, L., FONG, H. T., JAUNEAU, L. AND MORELLET, D. *C.R. Acad. Sci., Paris*, **226**, 1897–9 (*June* 7, 1948) *In*

French.—The second disintegration of a double star obtained in an emulsion at 4 300 m altitude is initiated by a σ-meson from the first disintegration. This first star appears to be initiated by a particle of intermediate grain count between proton and σ-meson and to require from energy considerations an incident particle of mass $> 800\ m_0$. The initiating primary is probably a meson of mass 1 000. J. G. W.

537.591

1085. A search for delayed photons from stopped sea level cosmic-ray mesons. SARD, R. D. AND ALTHAUS, E. J. *Phys. Rev.*, **74**, 1364–71 (*Nov.* 15, 1948).—If the meson disintegrates into a photon and an electron, the stopping of a meson and its subsequent decay should give rise to a delayed 50-MeV photon. Delayed coincidences were sought between the stopped meson and the photon, detected by its materialization in a Pb sheet (calculations are presented of the photon detection efficiency for various Pb thicknesses and photon energies of 20, 40 and 60 MeV; the electron range-energy curves used in the calculation are also shown). In 477·4 hours, nine apparent delayed photon coincidences were found. The measured inefficiency of the anticoincidence arrangement leads us to expect five spurious delayed photon coincidences in this time, so we conclude that the number of true delayed photon coincidences is small, if not zero. If the hypothesis under test is correct, the expected number of true delayed photon coincidences, computed from the rate of delayed electron coincidences (as measured with the same geometry) and the calculated photon detecting efficiency, is of the order of 100. The negative result of this test argues not only against decay into a photon and an electron, but also shows that if meson decay leads to a neutral meson which then decays into two photons, the mean life against the latter process must be greater than about 10^{-10} sec. A.

537.591 : 539.18

On the β-decay of mesons. *See Abstr.* 1168

537.591 : 539.18

The capture probability of negative mesotrons. *See Abstr.* 1169

537.591.15

1086. Shower production by penetrating particles at 14 000 feet. BRIDGE, H. AND HAZEN, W. *Phys. Rev.*, **74**, 579–88 (*Sept.* 1, 1948).—Showers produced by penetrating particles were studied at 14 000 ft by simultaneous observations with G.M. counters, a cloud chamber and an ionization chamber in a combined array. At least two-thirds of the observed showers generated by penetrating particles that struck a 5 in Pb absorber consisted of a mixture of energetic electrons and particles heavier than electrons. The frequency of these events at high altitude relative to sea level shows that the initiating particles are not ordinary mesons. The presence of heavier particles in the electron shower indicates that the showers result from nuclear interactions in which the nucleus is disrupted rather than from a simple radiation process. Details of the events and their relation to some other cosmic-ray phenomena are discussed. A.

537.591.15

1087. Further calculations on the cascade theory. BHABHA, H. J. AND CHAKRABARTY, S. K. *Phys. Rev.*, **74**, 1352–63 (*Nov.* 15, 1948).—The paper summarizes the previous work, and briefly gives the steps by which the mathematical solution of the cascade equations given in previous papers can be established rigorously. This solution has been used to calculate the number of shower particles for thicknesses between 0·25 characteristic unit and 20 characteristic units, and for primary energies from 2·7 times the critical energy ($y_0 = 1$) to $2{\cdot}7 \times 10^{10}$ times the critical energy ($y_0 = 24$). For this purpose, the second term of the series solution has also been calculated. The results are given in Table III and Fig. 3 in a form suitable for comparison with, and analysis of, experiment. These show that the second and higher terms of the series are negligible compared with the first for thicknesses less than three to four times that at which the shower reaches its maximum. A method has been developed which allows the integrals to be evaluated at very small thicknesses where transition effects are still of importance, so that it is now possible to trace a shower from its very beginning to large depths. It is shown that for very small showers started by particles of two to three times the critical energy the shower must penetrate to depths which are three times the maximum depth to which a single particle could penetrate as a result of collision loss alone. This is possible because part of the path of the shower is covered by photons alone which then materialize at a subsequent depth. A simple formula has been given which enables one to calculate with considerable accuracy the spectrum of shower electrons of energy much below the critical energy. It is proved that this spectrum increases monotonically with decreasing energy at all thicknesses. Its form is approximately that of a modified inverse square law at the maximum of the shower, the power of the law becoming higher with increasing depth. A.

537.591.15 : 537.591.8

1088. The penetrating particles in cosmic-ray showers: II. The lightly-ionizing penetrating particles in penetrating showers. ROCHESTER, G. D. AND BUTLER, C. C. *Proc. Phys. Soc., Lond.*, **61**, 535–41 (*Dec.*, 1948).—The momentum spectrum of the penetrating particles in a small sample of penetrating showers has been measured. Most of the particles are positive and have momenta of the order 10^9 eV/C. From a study of the interaction of these particles with nucleons in a lead plate it is concluded that whilst a small number may be μ-mesons most are protons, π-mesons or heavier mesons. A.

537.591.3

1089. Neutral decay products of cosmic radiation at great depth. BARNÓTHY, J. AND FORRÓ, M. *Phys. Rev.*, **74**, 1300–10 (*Nov.* 15, 1948).—The absorption curve of cosmic radiation was measured during a period of 7 yr in a coal mine at a depth of about 1 000 m w.e. (water equivalent). The shape of the curve and the counter-efficiency measurements suggest that the most penetrating component of cosmic radiation consists of non-ionizing or scarcely ionizing rays. It was found that the intensity decreases for inclined directions less than would correspond to the thickness of the material and its temperature coefficient is positive. All these experimental evidences, together with the known fact that at 400 m w.e. depth the

exponent in the intensity v. depth variation changes from 1·8 to 2·8, favour the view that the radiation present at 1 000 m w.e. depth is formed at the decay of the mesons in the atmosphere. Neutrini or neutral mesons may account for the findings. A.

537.591.5

1090. Measurements of the east-west asymmetry of cosmic rays at Hobart, Tasmania. FENTON, A. G. AND BURBURY, D. W. P. *Phys. Rev.*, **74**, 589–91 (*Sept.* 1, 1948).—Measurements of the high latitude asymmetry of cosmic rays have been made at Hobart in geomagnetic latitude 51·7° south. A Geiger counter telescope has been used at a zenith angle of 45° with and without 12·5 cm of Pb absorber. The asymmetry is increased by a factor just > 2 when the Pb is used. The increase indicates that the hard component of the radiation is responsible for the high latitude asymmetry, and the magnitude of the increase suggests a preferential absorption of negative particles by the Pb. A.

MAGNETISM 538

538.113

1091. Paramagnetic resonance in salts of the iron group—a preliminary survey: II. Experimental results. BAGGULEY, D. M. S., BLEANEY, B., GRIFFITHS, J. H. E., PENROSE, R. P. AND PLUMPTON, B. I. *Proc. Phys. Soc., Lond.*, **61**, 551–61 (*Dec.*, 1948).—Over a hundred salts of the iron group have been examined by the method of paramagnetic resonance at a wavelength of 3 cm, using magnetic fields up to 15 kilogauss at room temperature. The cases in which no absorption is observed have been further investigated at lower temperatures and shorter wavelengths. The results are considered for each paramagnetic ion in relation to the effects of the crystalline field theory. The ions Ti^{+++}, Fe^{++} and Co^{++} are found to have abnormally small spin–lattice relaxation times, while in Fe^{++} and Ni^{++} the energy levels are separated in zero magnetic field by as much as 1 cm^{-1} in most salts. A preliminary investigation of salts of the rare earth group indicates that spin–lattice relaxation times for most of these ions are also very short at temperatures above those of liquid H. A.

538.114

1092. The relation between magnetic dispersion and surface inhomogeneity of ferromagnetics. KIRKO, I. M. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 2) 227–30 (1948) *In Russian.*—Measurements of real and imaginary components of permeability in the frequency range 50–1 500 c/s were made on Fe cylinders with and without a screw thread cut into them, also with a screw thread filled in with a non-magnetic alloy but of the same electrical conductivity as iron. It is concluded that the falling off of permeability with increasing frequency is due to magnetic rather than electrical inhomogeneity of the surface. D. S.

538.114

1093. The application of the Bethe–Peierls method to ferromagnetism. WEISS, P. R. *Phys. Rev.*, **74**, 1493–504 (*Nov.* 15, 1948).—The method introduced by Bethe and Peierls for treating the problem of order-disorder in alloys is applied to the problem of ferromagnetism. The method is first applied to the Ising model of the spin in which case the treatment is much the same as it is for the alloy problem, as has already been pointed out by Peierls. The correct treatment of the spin is used for spin values of $\frac{1}{2}$ and 1 per atom. The critical temperatures of different types of lattices are investigated. The method gives results in agreement with the rigorous results of the Bloch spin-wave theory in that only 3-dimensional lattices are found to be ferromagnetic. The values of the critical temperatures of these lattices are found to lie between the value predicted by the two Heisenberg approximations. The discontinuity of the specific heat at the critical temperature is computed for a body-centred lattice and for the two values of the spin. The magnitude of the discontinuity $>$ that predicted by Heisenberg's first approximation. The magnitude for the spin 1 is $3{\cdot}4\,k$ per atom and compares favourably with the experimental value for iron. The susceptibility is computed as a function of the temperature above the critical point. The variation of the susceptibility with temperature does not obey the Curie–Weiss Law but displays some curvature. This curvature explains qualitatively the difference between the "paramagnetic" and ferromagnetic critical temperatures and also helps remove some of the discrepancy between the number of Bohr magnetons per atom as measured at high and low temperatures. A.

538.114 : 537.32

Effect of reversible and irreversible changes of magnetization on the thermo-electric power of ferromagnetics. *See Abstr.* 1034

538.22 : 538.113 : 546.15

1094. The magnetic susceptibility of atomic iodine. SCOTT, A. B. AND CROMWELL, T. M. *J. Amer. Chem. Soc.*, **70**, 3981–4 (*Dec.*, 1948).—An experimental determination was made. Values for $\chi_{mol.}$ were found to be $8{\cdot}7\times10^{-4}$ at 1 030° and $11{\cdot}2\times10^{-4}$ at 1 127°. The apparatus and method of measurements are given in detail. A.

538.221 : 538.65

1095. Interpretation of the influence of a magnetic field on the internal damping of ferromagnetic materials. BOULANGER, C. *C.R. Acad. Sci., Paris*, **226**, 1341–3 (*April* 26, 1948) *In French.*—The general shape of the curve of decrement against amplitude with different magnetic fields is described for soft magnetic materials and interpreted in terms of the domain theory. A. E. DE B.

538.222 : 538.224 : 539.4.016.2

1096. The effect of cold working on the magnetic properties of pure metals. REEKIE, J. AND HUTCHISON, T. S. *Phys. Rev.*, **74**, 610–20 (*Sept.* 1, 1948).—Experiments with Al and Cu of the highest purity obtainable show that the magnetic susceptibilities of these metals are appreciably altered by cold working. The paramagnetic susceptibility of Al is decreased by an amount reaching approximately 15% of the original value, and the diamagnetic susceptibility of Cu is also, numerically, decreased by nearly the same amount. This strain sensitivity of susceptibility cannot be accounted for by the presence of ferromagnetic impurities, but appears to be related to certain metallurgical changes which occur on cold

working. From a consideration of the magnitude of $\Delta\chi$ for different degrees of cold work and the phenomenon of "magnetic self-recovery" (observed in Cu but not in Al), it is concluded that the combined effects of lattice distortion and fragmentation probably give rise to the observed changes in magnetic susceptibility. An explanation of the results is suggested in terms of trapping of the "free" electrons in the cold-worked metal at points of considerable internal strain, and a simple application of Stoner's theory of the susceptibility of free electrons appears capable of giving a qualitative indication of why cold working should cause a change of χ towards increased paramagnetism in Cu but towards decreased paramagnetism in Al. A.

ELECTROMAGNETISM . ELECTRODYNAMICS 538.3/.5

538.3

1097. Classical electrodynamics without singularities. McMANUS, H. *Proc. Roy. Soc. A*, **195**, 323–36 (*Dec.*, 1948).—It is shown that it is possible to construct a theory of the electron with an extended charge distribution in a Lorentz invariant way by introducing a 4-dimensional form function. The electromagnetic field quantities reduce to those given by the ordinary theory at distances large compared with the electron radius r_0, but remain finite on the world line. The equations of motion, after elimination of the self field, become integro-differential equations. In the case of small accelerations an expansion in powers of r_0 similar to that of Lorentz is obtained, in which only odd powers of r_0 occur. The first term endows the electron with a mass component of electromagnetic origin. For accelerations small compared with the characteristic frequency $1/r_0$ of the electron, the Lorentz–Dirac equations are a good approximation; for larger accelerations, higher terms become important. A.

538.312 : 531.314.2

1098. An extension of Lagrange's equations to electromagnetic field problems. CROUT, P. D. *J. Appl. Phys.*, **19**, 1007–19 (*Nov.*, 1948).—This paper contains the basic theory of an extension of Lagrange's equations which renders these equations and the procedures associated with them in mechanics applicable to electromagnetic field problems such as are encountered in ultra high frequency work and other branches of engineering. In certain important cases the Lagrangian procedures so obtained give equivalent networks. Successful applications of these procedures to several practical problems are indicated. A.

538.54 : 621.365.92

1099. The detection of heating in liquid dielectrics at low frequencies. DODD, C. *Proc. Phys. Soc., Lond.*, **61**, 97–9 (*July*, 1948).—Very small heating could be measured from changes in viscosity; the liquid flowed in a narrow channel between massive steel plates to which the alternating potentials were applied. Rough quantitative values could be obtained at frequencies as low as 10 kc/s. Results for monochlorobenzene are briefly reported. L. S. G.

538.551.25/.3 : 621.396.611.1/.2

1100. Natural oscillations of a conservative, non-linear circuit. ZEITLIN, L. A. *J. Tech. Phys., USSR*, **18**, 757–64 (*June*, 1948) *In Russian.*—An analysis by Weierstrass' method of the amplitude and period of the oscillations, curves of the flux linking with the coil windings, and current intensity in a loss-less circuit containing iron, the oscillations being set up by a capacitor discharge. The characteristic difference between the present case and that of a linear circuit is the dependence of the period of the oscillations on the applied voltage. As the harmonic content of the magnetic flux curve is negligible, this curve is very nearly sinusoidal. The curves of terminal voltage and current show considerable deviations from the sine form owing to high harmonic content. Numerical integration of the oscillation equation is carried out for the case of a particular magnet steel whose magnetization curve permits a good representation by a 7th order relation between H and B.

538.56 : 535.42 : 621.396.677

1101. Solution of the problem of the diffraction of a plane electromagnetic wave on an infinite paraboloid of revolution by means of Laguerre functions. MIRIMANOV, R. G. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 2) 203–6 (1948) *In Russian.*—By the introduction of a suitable system of parabolic co-ordinates the wave equation takes a form in which the variables are separable. A change of variables then leads immediately to Laguerre's equations, solvable by Laguerrians of the 1st and 2nd kind. Expansion of the incident scalar plane wave in Laguerrians gives the general solution of the problem. In applying the principle demonstrated on the scalar wave equation to Maxwell's equation, the projections of the vector on the given co-ordinate directions must be separated from the covariant vector components. The ensuing system of 6 equations contains two auxiliary scalar functions which may be termed potentials and can be expanded in Fourier series, as can the covariant vector components. As there is no difficulty in determining the coefficients in these expansions, the further procedure is straightforward. B. F. K.

538.56 : 535.42 : 621.396.677

1102. Solution of the problem of the diffraction of a spherical electromagnetic wave on an unbounded paraboloid of revolution. MIRIMANOV, R. G. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 3) 357–60 (1948) *In Russian.*—The most important type of spherical wave from the viewpoint of applied electrodynamics is certainly that set up by an electric or magnetic dipole. Such a dipole in the focus of an infinite paraboloid is considered, with its axis $\perp$ the axis of the paraboloid. The treatment is analogous to the author's solution of the case of an elliptic wave [Abstr. 1101 (1949)].

B. F. K.

538.566 : 621.396.11

1103. On a generalization of Weyl's formula for the wave field above an absorbing plane. MALYUZHINETS, G. D. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 3) 367–70 (1948) *In Russian.*—A scalar wave field set up by an arbitrary source distribution in the half-space above an absorbing plane is considered. The required solution is represented as a sum of incident and reflected waves, the former being given. The history

of the problem in its acoustic and electro-magnetic variants is discussed and the intrinsic differences of these cases are pointed out, as reflected in the different character of boundary conditions applying in either case, differential equations and general form of the solutions being obviously identical. The general solution of the problem is found by an operator method, of which Weyl's well-known formula for propagation of radio waves is shown to be a special case, namely, that of a spherical wave due to a point source of definite location. Weyl's solution is that of the problem of the propagation of radio waves along the boundary of two homogeneous media, or, more accurately, the Green function of this problem.

B. F. K.

538.566 : 621.396.11

1104. Sommerfeld's surface wave. Final solution of a problem which has remained undecided for a long time. KAHAN, T. AND ECKART, G. *C.R. Acad. Sci., Paris*, **226**, 1513–15 (*May* 10, 1948) *In French.*—If a vertical electric dipole radiates over an ∞ horizontal conducting plane, there should be, according to Sommerfeld, a surface wave, which however has never been found experimentally. The authors prove that a correct application of the boundary conditions—i.e. that only divergent waves must be present at ∞—rules out the existence of such a surface wave. L. P.

538.566 : 621.396.11

1105. Surface currents on a conducting sphere excited by a dipole. PAPAS, C. H. AND KING, R. *J. Appl. Phys.*, **19**, 808–16 (*Sept.*, 1948).—Determines the current distribution on the surface of a perfectly conducting sphere when driven by a dipole aerial erected on its surface. Curves of the real and imaginary parts of the surface currents are given for the case of a $\lambda/2$ dipole and various radii of the sphere. A.

538.566 : 621.396.11

1106. Two theorems on the propagation of sine waves in arbitrary stratified media. ABELÈS, F. *C.R. Acad. Sci., Paris*, **227**, 899–900 (*Nov.* 3, 1948) *In French.*

538.566 : 621.396.11 : 517.947.44

1107. On the choice of the integration paths in the problem of the radiation of a dipole above a conducting plane. ECKART, G. AND KAHAN, T. *C.R. Acad. Sci., Paris*, **227**, 969–70 (*Nov.* 8, 1948) *In French.*—Following a previous note on the subject [see Abstr. 1104 (1949)] the mathematical reasons for the discrepancy between Weyl's and Sommerfeld's results on the existence of a surface wave are pointed out. L. P.

538.569.4 : 535.343.4–14 : 621.396.11

1108. Atmospheric absorption of the millimetre waves. LAMONT, H. R. L. *Proc. Phys. Soc., Lond.*, **61**, 562–9 (*Dec.*, 1948).—The attenuation of electromagnetic waves in the region of 5 mm wavelength due to resonance in the O_2 molecule was measured over atmospheric paths up to 2 km long, using a fixed transmitter and a mobile superhet. receiver. For 10 wavelengths between 6·34 and 4·48 mm values were obtained which, after reduction to standard dry atmospheric conditions, range up to a max. of 15·7 db/km at the peak of the absorption curve. They agree substantially with the theory of Van Vleck, and give a value of line-breadth constant $\Delta\nu$ of about 0·02 cm^{-1}, confirming estimates derived from other methods. A.

538.569.4 : 537.226.2/.3

Microwave absorption in liquids. *See Abstr.* 1015–17

MAGNETIC EFFECTS 538.6

538.65 : 621.318.22.042.2

1109. Anisotropic strains produced by surface abrasion, and their effect on the magnetic properties of silicon sheet steel. MARTINDALE, R. G. *J. Instn Elect. Engrs, Pt II*, **95**, 620–6 (*Oct.*, 1948).—Abrasion of Si–Fe sheets with a depth of cut $< 0{\cdot}0001$ in produces internal stresses of several thousand lb/in², of a markedly directional nature. Marked changes in permeability and magnetostriction are caused which can be explained in terms of domain distribution, and it is estimated that >60% of the domains become oriented in the sheet surface at right angles to the direction of abrasion. N. F. A.

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

1110. On the theory of metals. GOMBÁS, P. *Publ. Univ. Tech. Sci., Budapest* (*No.* 1) 25–9 (1947) *In German.*—A summary of results for the binding energy, compressibility and similar structure constants of the alkali and alkali-earth metals, using an empirical method of calculating the energy, including correlation effects. G. J. K.

539.11 : 532.782

1111. Theory of strain interaction of solute atoms. ZENER, C. *Phys. Rev.*, **74**, 639–47 (*Sept.* 15, 1948).—A general method is developed for evaluating the strain-energy interaction of solute atoms in body-centred and in face-centred cubic lattices. The method has many features in common with that used in the evaluation of the interaction of electric or magnetic dipoles, a surface distribution of forces replacing a surface distribution of electric charge or of magnetic poles. Particular emphasis is given to the interaction of interstitial solute atoms in b.c.c. lattices, where the possibility exists of a self-induced preferential distribution of solute atoms in one of the three types of tetragonal interstitial positions. A.

MOLECULAR STRUCTURE 539.13

539.13 : 537.533.73

1112. Electron-diffraction investigations of molecular structures. I. Application of Fourier analysis to the rotating-sector method. VIERVOLL, H. *Acta Chem.*

Scand., **1**, 120–32 (1947) *In English.*—Determination of molecular structures by use of the sector method is discussed, and different forms of distribution functions introduced by Fourier analysis are compared. The experimental distribution curves for complicated molecules are difficult to interpret because of diffraction effects, but this may be overcome by preparing curves, including the diffraction effects, for any atomic distance. B. A.

539.132 : 535.375.5 : 541.57

1113. Force constants and frequency assignments for some substituted methylacetylenes. MEISTER, A. G. *J. Chem. Phys.*, **16**, 950–9 (*Oct.*, 1948).—Force constants have been determined for methylacetylene using the Wilson FG matrix method. It was found that of the 13 force constants required for the potential energy function for methylchloroacetylene, methylbromoacetylene and methyliodoacetylene, 8 could be transferred from the set obtained for methylacetylene. Since only 4 of the 10 fundamental frequencies of the methylhaloacetylenes were used in establishing the force constants, all the frequencies were calculated to see if the sets of force constants for the methylhaloacetylenes were reasonable. With the exception of one frequency, the agreement between the calculated and observed values was within 2%. It was found that previous assignments by Cleveland and Murray of the observed Raman frequencies for methylbromoacetylene and methyliodoacetylene had to be modified. Assignments are given for some of their observed values for these 2 molecules and assignments are also given for their observed Raman frequencies for a solution of methylchloroacetylene in ethylbromide, also fundamental frequencies for methyldeuteroacetylene using the same force constants, interbond angles and equilibrium values for the bond distances as for methylacetylene. The C—C and C≡C stretching frequencies were found > for the methylhaloacetylenes than for methylacetylene or methyldeuteroacetylene. The C—X (X = halogen atom) stretching frequencies for the methylhaloacetylenes were found < for the corresponding methyl halides despite the fact that the C—X stretching force constant for the methylhaloacetylenes is always > for the corresponding methyl halides. A.

539.132 : 539.152.2

1114. The interaction of nuclear electric quadrupole moments with molecular rotation in asymmetric-top molecules. I. BRAGG, J. K. *Phys. Rev.*, **74**, 533–8 (*Sept.* 1, 1948).—The theory of the interaction of nuclear electric quadrupole moments with molecular rotation is extended to asymmetric-top molecules containing one or two quadrupolar nuclei. The first-order theory is developed in detail, and in a form which makes use of published numerical tables of line strengths of asymmetric-top pure rotation transitions, and involves the second derivatives of the electrostatic potential V taken along the three principal axes of inertia. Only two of these are independent, and $(\partial^2 V/\partial z'^2)$ and $(\partial^2 V/\partial x'^2) - (\partial^2 V/\partial y'^2)$ are a convenient choice of the parameters of the problem. A general formulation of the theory, which includes higher order effects, is given. In case a molecule contains only one quadrupolar nucleus, the structure of the quadrupole multiplets should be sufficient to identify pure rotation transitions. A

539.132 : 541.57

1115. Electronic structure of aromatic hydrocarbons with 4 condensed benzene rings. Study by the method of molecular orbitals. BERTHIER, G., COULSON, C. A., GREENWOOD, H. H. AND PULLMAN, A. *C.R. Acad. Sci., Paris*, **226**, 1906–8 (*June* 7, 1948) *In French.*

539.132 : 541.57

1116. The electronic structure of conjugated systems. V. The interaction of two conjugated systems. COULSON, C. A. AND LONGUET-HIGGINS, H. C. *Proc. Roy. Soc. A*, **195**, 188–97 (*Dec.* 7, 1948).—The interaction of two conjugated systems across a conjugated single bond is discussed. It is shown that the conjugation energy across the bond, and the mobile order of the bond, are both positive, and that both are closely related to the self-polarizabilities of the atoms forming the bond. This relation forms the basis for a definition of the conjugating power of a position as β times its self-polarizability. The conjugating power of various hydrocarbon residues is shown to increase in the order: phenyl, β-naphthyl, 2-butadienyl, α-naphthyl, vinyl, 1-butadienyl. A

ATOMIC STRUCTURE . ISOTOPES 539.1

539.152.

1117. Remarks on [nuclear] isomerism. LACROUTE, P. *C.R. Acad. Sci., Paris*, **226**, 1804–6 (*May* 31, 1948) *In French.*—From a survey of experimental data, it is concluded that, where isomerism occurs in nuclei with a certain number α of protons, it also tends to occur in nuclei having α neutrons. Examples of this correspondence are listed for 9 values of α between 27 and 79. A. P. H.

539.152.

1118. Erratum: The radial dependence of the tensor force in the deuteron. GUINDON, W. G. Letter in *Phys. Rev.*, **74**, 699 (*Sept.* 15, 1948).—See Abstr. 2900 (1948).

539.152.

1119. Note on nuclear magnetic resonance. SCHNEIDER, E. E. *Proc. Phys. Soc., Lond.*, **61**, 569–71 (*Dec.*, 1948).

539.152.

1120. Investigations on the binding energy of heavy nuclei. HUBY, R. *Proc. Phys. Soc., Lond., A*, **62**, 62–71 (*Jan.*, 1949).—The binding energy of a heavy nucleus is one of the quantities which a satisfactory nuclear force theory ought to predict correctly. Approximate calculations of this binding energy are performed, taking as nuclear force the static interaction of Møller and Rosenfeld. The parameters appearing in the interaction have been fixed by data on light nuclei. The Fermi-gas model is taken as basis for the calculations, a first solution being obtained by a first-order perturbation (or variation) method. For refinement, a second-order perturbation calculation is made, and Svartholm's variation iteration method is attempted. The first-order result yield about 10% of the required energy, and the

second-order about 40%; a reasonable prediction of the size of the nucleus is obtained. The reliability of the perturbation results is uncertain; Svartholm's method does not appear to be well suited to the investigation of heavy nuclei. Two alternative modifications are made to the nuclear force to make it yield the correct binding energy according to the perturbation calculation. A.

539.152.1 : 537.122

1121. Some effects of the intrinsic magnetic moment of the electron. Breit, G. *Phys. Rev.*, **74**, 656–63 (*Sept.* 15, 1948).—Effects of the magnetic moment of the electron of the 6-vector type are calculated. According to the hypothesis followed here, the electron's behaviour in the field of a nucleus is described only approximately as that of a point charge. More accurately, it behaves as a particle having mainly the properties of a point charge which are corrected by the addition of a small "intrinsic" magnetic moment. In the present note the purely empirical point of view of an intrinsic magnetic moment is followed without any attempt at a justification from the point of view of quantum electrodynamics which has been given by Schwinger. Formulae are worked out for the effect on hyperfine structure, on the Landé *g*-factor and the contribution to the Lamb–Retherford line shift. The arrangement of the calculations is such as to have the same system for the ordinary hyperfine structure and the other effects. The finite rather than zero size of the nuclear current system is explicitly included in the formulae. A.

539.152.2

1122. Further remarks on the magnetic moments of H^3 and He^3. Avery, R. and Sachs, R. G. *Phys. Rev.*, **74**, 1320–2 (*Nov.* 15, 1948).—Arguments for the existence of exchange moments in these nuclei depend on an accurate evaluation of the spin and orbital contributions to the moments. Assumptions made in previous evaluations are re-examined. Although the results do not establish the existence of the exchange moment conclusively, arguments are presented which make the alternative appear to be less reasonable. Methods for obtaining further information on this question are discussed. A.

539.152.2 : 537.228.5

1123. Nuclear quadrupole interaction in CsF. Trischka, J. W. *Phys. Rev.*, **74**, 718–27 (*Oct.* 1, 1948).—The electric resonance method of molecular beam spectroscopy has been used under high resolution conditions to study the rotational Stark spectrum of CsF for a single rotational state of the molecule, $J = 1$. In this method polar molecules in a single rotational state and a particular state of space quantization are selected from a molecular beam by means of inhomogeneous electric fields which give the desired molecules a unique, sigmoid path in the apparatus. Changes in the beam intensity are observed when a change in the space quantization of the molecule is produced by an oscillating electric field transverse to a homogeneous, steady electric field. For weak electric fields the observed line widths agree well with the estimated uncertainty width of 10 kc/sec. At stronger fields inhomogeneities in the field cause a broadening of the lines. At sufficiently strong fields the spectrum for CsF contains several broad lines, each of which is due to transitions of molecules in a particular vibrational state. As the field strength is decreased the resolution improves and these lines reveal a complex fine structure, the principal features of which can be explained by the interaction of the electric quadrupole moment of the Cs nucleus, spin 7/2, with the molecular electrons and the F nucleus. The F nucleus, spin 1/2, has no quadrupole moment. A complete, quantitative explanation of the spectra requires the existence of a cosine type coupling between the nuclear spins and the molecular spin of the form $c\mathbf{I}\cdot\mathbf{J}$, and a correction for the spin-spin interaction of the two nuclei. At weak fields a different type of spectrum appears, permitting an independent evaluation of the nuclear-molecular interactions. The data allows a determination of both the magnitude and sign of the interaction constants. The quadrupole interaction, defined by $(e^2q'Q/2h)$, is $(+\,0{\cdot}310 \pm 0{\cdot}002)$ mc/sec. The constants, c/h, for the $\mathbf{I}\cdot\mathbf{J}$ interactions for F and Cs are, respectively, $(+\,16 \pm 2)$ kc/sec and (0 ± 1) kc/sec. The difference in the quadrupole interaction for the first two vibrational states is less than the experimental error; i.e. $<1\%$. Application of the method to the measurement of various molecular constants is discussed briefly at the end of the paper. A.

539.152.2 : 538.222

1124. Magnetic resonance absorption in the chrome alums. Whitmer, C. A., Weidner, R. T., Hsiang, J. S. and Weiss, P. R. *Phys. Rev.*, **74**, 1478–84 (*Nov.* 15, 1948).—Measurements of paramagnetic resonance absorption at room temperature in single crystals of potassium chrome alum and ammonium chrome alum made at a frequency of 9 375 Mc/s are described. The method makes use of a magic-*T* bridge with a low level crystal detector which essentially measures the magnetic susceptibility. Data are given for three orientations of the crystals for both the diluted and undiluted salts. The Stark splitting and the *g*-factor of the ground state are evaluated from the positions of the absorption peaks. The theory which is used for the computation of the Stark splitting is extended to include the (110) orientation. A.

539.152.2 : 548.0 : 535.338.32

The dipolar broadening of magnetic resonance lines in crystals. *See Abstr.* 949

539.153 : 535.338

1125. Configurations of the low terms of Ti II. Russell, H. N. *Phys. Rev.*, **74**, 689–90 (*Sept.* 15, 1948).—Series relations among the high even terms of Ti I afford conclusive evidence that the lower of the two ^4F terms in Ti II arises from the configuration d^2s, and the other from d^3. A.

539.153 : 535.338

1126. On the configurations d^2sp, d^3p, and d^7p. Rohrlich, F. *Phys. Rev.*, **74**, 1372–80 (*Nov.* 15, 1948).—The energy matrices of the configurations d^2sp, d^3p and d^7p are calculated in terms of Slater's F^k and G^k integrals for Russell–Saunders coupling. The calculations are based on Racah's method of tensor operators. A.

539.153 : 535.338

1127. The classification of the odd terms of Ti I. Rohrlich, F. *Phys. Rev.*, **74**, 1381–96 (*Nov.* 15, 1948).—The odd configurations $3d^24s4p$, $3d^34p$ and

$3d4s^24p$ of Ti I are calculated [see Abstr. 1126 (1949)]. Numerical values for the F^k and G^k integrals are found by comparison with the observed levels in a method of successive approximation. A correction is applied for configuration interaction which improves the general agreement. Explicit formulae are given for the multiplet strengths of transition arrays involving equivalent electrons. They are applied to the transitions $d^2sp - d^3s$ and $d^2sp - d^2s^2$ of Ti I. Tables of multiplet strengths are calculated corresponding to interaction energies diagonal in first-order and second-order eigenfunctions, respectively. On the basis of these calculations and known measurements of line intensities and gf values, a new classification of the odd terms of Ti I is proposed. Of the 83 observed odd terms, 76 were classified. In 74 cases the calculated terms fit with a mean deviation of $\pm$ 1 023 cm^{-1} on a range of about 30 000 cm^{-1}. Although the experimental data on multiplet strengths are rather scarce, they seem to be in better agreement with theory when based on the new classification. A.

539.153.4 : 535.338.332

1128. Effect of nuclear motion on the fine structure of hydrogen. BREIT, G. AND BROWN, G. E. *Phys. Rev.*, **74**, 1278–84 (*Nov.* 15, 1948).—The problem is re-examined from the point of view of the Hamiltonian applicable to two charged particles and accounting for effects of order v^2/c^2, where v is the velocity. The work differs from that of Bechert and Meixner in that the energy of the Dirac electron in a central field is taken as the reference point. The solution is carried out in terms of an eight-component rather than a four-component approximation to the 16-component wave function. The result is the same for practical purposes as that of Darwin for the prequantum-mechanical problem and of Bechert and Meixner for the four-component approximation. The energy formula is affected only by the original Bohr reduced mass correction to the term value and also by a term which is independent of the particular fine structure component and depends only on the principal quantum number. Bethe's electrodynamic shift is, therefore, not obscured to within terms of relative order $\alpha^2(m/M)$ by effect of nuclear motion. A.

539.155.2

1129. The isotopic constitution of europium, gadolinium, and terbium. HESS, D. C., JR. *Phys. Rev.*, **74**, 773–8 (*Oct.* 1, 1948).—The isotopic abundances of Eu, Gd and Tb have been determined electrometrically by means of a mass spectrometer. The abundances of Eu isotopes of masses 151 and 153 were found to be 47·77 and 52·23%, respectively. For Gd, masses 152, 154, 155, 156, 157, 158 and 160 were found to have abundances of 0·20, 2·15, 14·78, 20·59, 15·71, 24·78 and 21·79%, respectively. Upper limits for the existence of other isotopes of these elements were determined. A.

539.155.2 : 538.691

1130. Concentration of stable isotopes by the electromagnetic method. KEIM, C. P. *Chem. Engng News*, **25**, 2624–5 (1947).—A short restatement of the separation method of the mass spectrograph, followed by an account of the metallic isotopes which have so far been purified by this method. It is claimed that concn. of a typical isotope in a mixture may be $\times 20$ in one step, but no details of quantities involved are given. B. A.

539.155.2 : 538.691

1131. The varieties, quantities, and purities of stable isotopes which have been concentrated electromagnetically. KEIM, C. P. Letter in *Science*, **108**, 541 (*Nov.* 12, 1948).

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16

1132. Industrial radioactivity uses suggested. *Chem. Engng News*, **25**, 2980 (1947).—Some uses outlined include (*a*) the use of radioactive Na oleate in the coating of rayon fibres with Na oleate–oil so as to ensure uniformity of deposition, (*b*) the marking of tools, products, etc., so that they may be traced, and (*c*) the simplification of mixing problems, e.g. the use of radioactive P in laboratory electric steel furnaces for determining the rate of approach to equilibrium with varying temp. and other conditions. B. A.

539.16 : 539.164

1133. An experiment to detect radiation from U^{235} [Actinuran]. SCHINTLMEISTER, J. *S.B. Akad. Wiss. Wien*, **148**, *Abt. IIa* (*Nos* 5–6) 236–78 (1939) *In German.*—It was attempted to detect α-ray radiation from U^{235} included in a thin homogeneous layer containing U^{238}, U^{235} and U^{234}. A valve electrometer and a special ionization chamber were used. Apart from the known ranges of rays from U^{238} and U^{234}, no radiation traceable to U^{235} could be found. The theoretical range distribution of α-rays from a U-layer of finite thickness is calculated. V. W. R.

539.16.08 : 537.542

1134. Erratum: Geometric factors underlying coincidence counting with Geiger counters. NEWELL, H. E., JR. *Rev. Sci. Instrum.*, **19**, 824–5 (*Nov.*, 1948).—See Abstr. 3880 (1948).

539.16.08 : 537.56

1135. The wall effect of cylindrical boundaries on radioactive substances. BERGER, E. R. *S.B. Akad. Wiss. Wien*, **150**, *Abt. IIa* (*No.* 8) 131–55 (1941) *In German.*—A cylindrical chamber is filled with radioactive gas, ionized by α-rays, and fitted with a central negatively charged rod electrode. The lines of force, initial and total currents are calculated for the case where the chamber height and radius > greatest range of the rays. The radiation losses due to the walls and the distribution of active deposit on the electrode is found. A standardized measuring chamber is investigated. Formulae permit absolute emanation measurements with a "guard-cylinder" condenser, which is superior to the usual guard-ring plate condenser. V. W. R.

539.162 : 539.167.3

1136. A new radioactive series—the protactinium series. STUDIER, M. H. AND HYDE, E. K. *Phys. Rev.*, **74**, 591–600 (*Sept.* 1, 1948).—A new series of radioactive isotopes has been produced by deuteron and helium ion bombardments of Th. The identity radiations, energies and ½-lives of the five members

of this series, which is a branch of the U–Ra series and joins it at RaC′, are given. A simple electronic device was developed to measure the short ½-life of Em^{218}. A.

539.163

1137. The question of dual disintegration of radium A. KARLIK, B. AND BERNERT, T. *S.B. Akad. Wiss. Wien*, **151**, *Abt. IIa* (*Nos* 9–10) 255–65 (1942) *In German.*—Experiments to detect β-radiation from RaA gave negative results. A critical consideration of possible sources of error indicates that the deviation from the theoretical disintegration curve of RaA found by Minder [Abstr. 4881 (1938)] is due to formation of active deposits. Hence Minder's attempt to prove the presence of element 85 is inconclusive. V. W. R.

539.163 : 539.155.2

1138. Radioactive isotopes of Ga and Ge. MCCOWN, D. A., WOODWARD, L. L. AND POOL, M. L. *Phys. Rev.*, **74**, 1311–14 (*Nov.* 15, 1948).—The radioactive Ge isotope of 1·65 d ½-life has been produced by Zn(α,n), Ga(d,2n), and Ge(n,2n) reactions, but not by d-bombardment of Ge. This isotope is reassigned and placed at Ge^{69}. It decays with emission of p's, X-rays and γ-rays. No evidence for the existence of the 195 d period has been found at Ge^{69} by d-bombardment of Ga. The characteristic X-ray lines of Ga from decay activity of the 11·4 d Ge^{71} have been photographed by a curved crystal camera. d-bombardment of Ge^{76}, enriched electromagnetically to 70%, has given no evidence of a 9 d period at Ga^{74}. The ½-life of Ge^{75}, produced by fast n-bombardment of As, is $1{\cdot}37 \pm 0{\cdot}02$ hr. The ½-life of Ga^{67}, produced by α-particle bombardment of Zn, is $3{\cdot}26 \pm 0{\cdot}02$ d. A.

539.163.1 : 550.367

1139. On the total half-life period of K^{40}. GRÁF, T. Letter in *Phys. Rev.*, **74**, 1199–1200 (*Nov.* 1, 1948).—The total ½-life of K^{40} is recalculated to be $4{\cdot}0 \pm 0{\cdot}5 \times 10^8$ years by combining the partial ½-life for β-decay obtained by Gráf [Abstr. 680 (1949)] and the Ca^{40}/K^{40} ratio in lepidolites obtained by Ahrens and Evans [Abstr. 3895 (1948)]. The geophysical significance of the new value is discussed. B. R.

539.163.2 : 539.164

1140. New determination of the range of the α-rays from uranium. SCHINTLMEISTER, J. AND LINTNER, K. *S.B. Akad. Wiss. Wien*, **148**, *Abt. IIa* (*Nos* 5–6) 279–95 (1939) *In German.*—The amount of ions produced by single α-rays from a thin homogeneous U preparation was measured by a valve electrometer, and the range statistically calculated. An extrapolated range of $2{\cdot}59 \pm 0{\cdot}01$ cm at 0°C was found for U^{238}, and $3{\cdot}11 \pm 0{\cdot}01$ cm for U^{234}, and the max. ranges are also given. For thorium the range in air at 0°C is $2{\cdot}58 \pm 0{\cdot}01$ cm. A survey of range measurements by various authors is included. V. W. R.

539.163.4

1141. De-emanation of strong radium C preparations. KARLIK, B. AND BERNERT, T. *S.B. Akad. Wiss. Wien*, **151**, *Abt. IIa* (*Nos* 9–10) 267–75 (1942) *In German.*—When a strong RaC preparation is used in nuclear physics experiments, any emanation inclusions remaining from its manufacture must be removed, otherwise they will interfere with radiation measurements. This is achieved by heating in a vacuum after temporary oxidation, without incurring noticeable loss of RaC or α-ray range. The volatility of RaB + C in a vacuum is very much higher than previously expected; in the case of a N-atmosphere chemical combination of RaC is likely. An improved method of measuring radiation range by luminescence is given. V. W. R.

539.164 : 537.531

1142. Action of ionizing radiations on ethyl iodide. LEFORT, M., BONÉT-MAURY, P. AND FRILLEY, M. *C.R. Acad. Sci., Paris*, **226**, 1904–5 (*June* 7, 1948) *In French.*—When C_2H_5I is bombarded either with X-rays or with α-particles, there is strict proportionality between the radiation dose (ergs/cm³) and the quantity of I liberated, but X-rays are more efficient, so that the linear density of the ionization is involved in the same way as for aqueous solutions. The results suggest that some C_2H_5I molecules are excited by the radiation and then dissociate into I and C_2H_5. This decomposition might be used for radiation dosimetry. C. B. A.

539.164.93

1143. Radiation chemistry. DAINTON, F. S. *Research, Lond.*, **1**, 486–92 (*Aug.*, 1948).—The mechanism of the initiation of chemical reactions by ionizing radiations is reviewed and discussed. C. B. A.

539.165 : 537.533.74

1144. The scattering of fast β-particles through large angles by nitrogen nuclei. CHAMPION, F. C. AND ROY, R. R. *Proc. Phys. Soc., Lond.*, **61**, 532–5 (*Dec.*, 1948).—A combined arrangement of counters and a cloud chamber is used to examine the elastic large-angle scattering of β-particles of approximately 1 MeV energy by N nuclei. In a total effective track length of nearly 100 km, 131 photographs were obtained in which the scattering angle exceeded 85°. Considering the present results on large-angle scattering, together with earlier results on the scattering at smaller angles, the agreement between experiment and Mott's theory is good over the entire angular range 20–180°. A.

539.165.1/.2

1145. The β-radiations of MsTh2 and MsTh1. LECOIN, M., PEREY, M. AND TEILLAC, J. *C.R. Acad. Sci., Paris*, **227**, 121–3 (*July* 12, 1948) *In French.*—A Wilson chamber working at ordinary pressures with MsTh2 was used to show that there are as many electrons above as below an energy of 60 keV, and that there appear to be 2 β-particles per disintegration. With a chamber designed for reduced pressures, at a pressure of 20 cm Hg, tracks attributable to MsTh1 were found. These form a spectrum with end point 12 keV and with 2 maxima at 3 and 5 keV. The measurements extended down to 1·5 keV, yet the number of electrons observed corresponded to only 15% of the disintegrations. R. W. P.

539.165.2

1146. Relation between apparent shapes of monoenergetic conversion lines and of continuous β-spectra in a magnetic spectrometer. OWEN, G. E. AND PRIMAKOFF, H. *Phys. Rev.*, **74**, 1406–12 (*Nov.* 15, 1948).—A method has been worked out for correcting

distortions which affect the apparent shape of a continuous β-ray spectrum. Internal conversion lines are studied in the β-spectrometer and found to have a finite width and in the case of 180° focusing an unsymmetrical shape. On the assumption that these conversion lines are actually monoenergetic, it is possible to calculate the distortion produced by the spectrometer and source, and thus to determine the approximate true shape of the continuous β-ray spectrum from the experimental data. The Kurie plots for a continuous β-ray spectrum corrected in this way are, in general, straight over a greater range than the plots of the uncorrected data. The correction has been applied to the ratio of the number of positrons to the number of negatrons in Cu^{64} and gives results in better agreement with the Fermi theory than if there has been no correction. A.

539.165.2

1147. The nuclear β-spectra of thorium B → C and C → C′, and the intensities of some β-ray lines of thorium (B + C + C″). MARTIN, D. G. E. AND RICHARDSON, H. O. W. *Proc. Roy. Soc. A*, **195**, 287–300 (*Dec.* 22, 1948).—The β-spectra of Th(C + C″) and Th(B + C + C″) have been measured using semi-circular focusing. The sources were mounted between two thin films to prevent the escape of ThC″ by α-recoil. The intensities of seven of the β-ray lines were measured and the continuous spectra of ThB . C and ThC . C′ were found by subtraction using the known spectrum of ThC″ . D. The β-ray end-point of ThC . C′ is at 2·250 MeV, and the shape of the β-ray spectrum differs but little from that of an allowed transition for energies above 0·9 MeV. A detailed comparison is made with the shape of the compound spectrum required to account for the known γ-rays of ThC′, using the theory of forbidden transitions. A spin change of $\Delta I = \pm 2$ is ruled out, but $\Delta I = 0$ or ± 1 is possible. The β-spectrum of ThB seems to be composite with its principal end-points at 0·331 and 0·569 MeV. The intensity of the high-energy transition between the ground states is about 0·12 ± 0·02 electrons per disintegration. The K internal conversion coefficient of the F γ-ray was found to be about 0·377, 16% higher than the theoretical value for magnetic dipole radiation. A.

539.165.2 : 539.167.3

1148. Study of the beta-spectra of C^{14} and S^{35}. COOK, C. S., LANGER, L. M. AND PRICE, H. C., JR. *Phys. Rev.*, **74**, 548–52 (*Sept.* 1, 1948).—Using sources of high specific activity, the β-spectra of C^{14} and S^{35} have been investigated in a large magnetic spectrometer. Since the distributions are measured under essentially identical conditions, a direct comparison of the data is possible. The S^{35} spectrum is in agreement with that predicted by the Fermi theory for energies from $W = 1{\cdot}15\,mc^2$ to the end point at $W_0 = 1{\cdot}331\,mc^2$. Below this region, there is a deviation from the theory the exact nature of which is unfortunately somewhat masked by distortions due to source thickness and backing. The C^{14} spectrum has a shape which is slightly different from that which would be predicted for an allowed transition. The experimental shape is not consistent with that calculated for a second forbidden transition using Fermi selection rules. The extrapolated end point for C^{14} is at $W_0 = 1{\cdot}306\,mc^2$. From the shape of the S^{35} spectrum in the neighbourhood of the end point, an upper limit is obtained for the mass of the neutrino as less than 1% the mass of the electron. A.

539.166 : 537.132 : 537.12

Two- and three-photon electron-positron annihilation selection rules. *See Abstr.* 1005–7

539.166 : 539.185 : 537.13

1149. Continuous γ-emission in neutron–proton collisions. KROOK, M. *Proc. Phys. Soc., Lond., A*, **62**, 19–26 (*Jan.*, 1949).—The cross-section for Bremsstrahlung in n–p collisions is calculated with a central exchange-force model and for energies $\leqslant 20$ MeV. It is found to lie between 10^{-28} and 10^{-29} cm². This is probably too small to be measured with experimental techniques at present available. A.

539.166.1/.2

1150. Polarization and direction of propagation of successive quanta. HAMILTON, D. R. *Phys. Rev.*, **74**, 782–8 (*Oct.* 1, 1948).—The correlation between the direction of propagation of one quantum and the polarization of another quantum, when the two are emitted successively (in any order) by a radiating system, is investigated theoretically. This direction-polarization correlation is found to be capable of determining the relative parities of all three levels of the radiating system. The correlation is simply related to the already investigated correlation between the directions of propagation of two successive quanta. Results are given explicitly for the possible combinations of dipole and quadrupole radiation. The discussion applies also to certain types of resonance radiation. A.

539.166.2 : 539.167.3

1151. Some measurements of gamma-ray energies. KURIE, F. N. D. AND TER-POGOSSIAN, M. *Phys. Rev.*, **74**, 677–82 (*Sept.* 15, 1948).—To examine the possibility that some radio-isotopes which have been considered to decay by K-capture do in part decay with the emission of very slow positrons careful measurements of the γ-rays emitted by two of them have been made. Preliminary measurements were made of the F and I lines of ThB as a check on the spectrometer used. Also the annihilation radiation line of Cu^{64} was measured to establish its shape and position. In the course of this, good evidence was found for radiation resulting from annihilation while the positron is in flight. The weak high energy gamma-ray previously reported was found and its energy determined to be 1·34 ± 0·01 MeV. The γ-radiation of both Be^7 and Cr^{51} consists of a single line at 485 ± 5 keV and 320 ± 5 keV, respectively. No evidence of annihilation radiation was found in either case. A.

539.167.3

1152. Radiations from platinum (193) and gold (199). MANDEVILLE, C. E., SCHERB, M. V. AND KEIGHTON, W. B. *Phys. Rev.*, **74**, 601–5 (*Sept.* 1, 1948).—The 4 d platinum activity, Pt^{193}, was induced in metallic platinum irradiated by neutrons in the pile at Oak Ridge. This isotope was found to emit conversion electrons of energy 0·115 MeV and X-rays of energy 70 keV. β–γ-coincidence measurements showed that the conversion electrons are coupled

with little or no γ-ray energy. γ–γ-coincidences, probably γ-(X-ray) coincidences, were found in Pt^{193}. Al absorption gave a maximum energy of 0·38 MeV for the β-rays of the 3·3 d Au^{199}; Pb absorption indicated γ-radiation of energy 0·18 MeV. β–β- and β–γ-coincidences were present in Au^{199}, but no γ–γ-coincidences were found. The absorption and coincidence measurements are combined to construct a disintegration scheme for Au^{199}. A.

539.167.3

1153. Short-lived isomers of nuclei. DeBenedetti, S. and McGowan, F. K. *Phys. Rev.*, **74**, 728–35 (*Oct.* 1, 1948).—A search for short-lived nuclear isomers of $\frac{1}{2}$-lives between 10^{-6} and 10^{-3} sec has been performed using the method of delayed coincidences between two Geiger counters. A short-lived isomer was detected by the measurement of the time lapsed between β-decay and γ- (or internal conversion electron) emission. Out of 60 nuclei investigated, 4 short-lived isomeric states were found: Ta^{181*} (22 μsec), Re^{187*} (0·65 μsec), Tm^{169*} (1 μsec) and Tm^{171*} (2·5 μsec). A.

539.167.3 : 539.155.1/.4

1154. Mass spectrographic mass assignment of radioactive isotopes. Hayden, R. J. *Phys. Rev.*, **74**, 650–3 (*Sept.* 15, 1948).—Characteristics of positive ion emission for various compounds on a W filament are noted. Methods of analysis of mixtures of radioactive isotopes by mass spectrograph are described. The following mass assignments are made: 108 d Y, 88; 57 d Y, 91; 1 yr Ru, 106; 300 d Ce, 144; 3·7 yr element 61, 147; 55 d Sr, 89; 25 yr Sr, 90; 60 hr Y, 90; 12·6 d Ba, 140; 40 hr La, 140. A.

539.167.3 : 539.155.2

1155. Radioactive Kr isotopes. Woodward, L. L., McCown, D. A. and Pool, M. L. *Phys. Rev.*, **74**, 761–4 (*Oct.* 1, 1948).—A radioactive isotope of 1·1 hr $\frac{1}{2}$-life has been produced in Kr by α-particle bombardment of Se^{74}, enriched electromagnetically from 0·9 to 14·1%. Assignment of the isotope is made to Kr^{77}. Al absorption measurements indicate a positron end point of 1·7 MeV. In addition to annihilation radiation, γ-rays and K-capture have been observed. The ratio of K-capture to positron emission from the $Se^{74}(\alpha,n)$ reaction is computed as 2·6. The Kr 1·42 d isotope has been produced by an (α,n) reaction on electromagnetically enriched Se^{76}. The isotope is located as Kr^{79} and its $\frac{1}{2}$-life confirmed. A positron end point of 1·0 MeV is determined by Al absorption measurements. In addition to annihilation radiation, γ-rays and K-capture have been observed. The ratio of K-capture to positron emission from the $Se^{76}(\alpha,n)$ reaction is computed to be 50. The cross-section ratio for formation of Kr^{77} compared to Kr^{79} by α-particle bombardment of Se is computed as 1·4. The 4·6 hr Kr^{85} isotope has been produced by a $Se(\alpha,n)$ reaction. A.

539.167.3 : 539.165 : 539.166

1156. The beta- and gamma-rays of Rb^{86}. Zaffarano, D. J., Kern, B. D. and Mitchell, A. C. G. *Phys. Rev.*, **74**, 682–6 (*Sept.* 15, 1948).—The β- and γ-rays of Rb^{86} (19·5 d) have been measured in a magnetic lens spectrometer. Measurement of the energies of photoelectrons produced in a Pb radiator shows one line corresponding to a γ-ray of energy 1·081 MeV. The β-ray spectrum is resolvable into two groups with end point energies of 1·822 and 0·716 MeV. A.

NUCLEAR REACTIONS 539.17

539.17

1157. On the range distribution of the heavy fission fragments of uranium under bombardment by slow neutrons. Jentschke, W. and Lintner, K. *S.B. Akad. Wiss. Wien*, **151**, *Abt. IIa* (*Nos* 9–10) 323–34 (1942) *In German.*—The range distribution spectrum of U fission fragments was measured by a coincidence-counter circuit with 0·4 MeV sensitivity limit. Measurements were carried out in A, N and air. Max. ranges of 25·6 mm and 18·0 mm ± 1 mm were found for the two types of fragments in air at 0°c and 760 mm Hg. The relation between range and energy of the fragments is discussed. V. W. R.

539.17

1158. On the angular distribution in nuclear reactions and coincidence measurements. Yang, C. N. *Phys. Rev.*, **74**, 764–72 (*Oct.* 1, 1948).—Theorems concerning the general form of the angular distribution of products of nuclear reactions and disintegrations are derived. These theorems are based only on the invariance properties of the physical process under space rotation and under inversion. The following examples are studied in detail: (i) angular correlation between the electron and the neutrino in β-decay; (ii) angular correlation between a β-ray and a γ-ray emitted in succession by a nucleus; and (iii) angular correlation between two γ-rays emitted in succession by a nucleus. A.

539.17 : 539.163.4

1159. The discovery of uranium fission. Hahn, O. *Experientia*, **4** (*No.* 10) 371–3 (1948) *In German.*—A historical survey of the work done by Hahn, Meitner and Strassmann which led to the discovery of the fission of U. The further work under the author's guidance in his institute (Kaiser Wilhelm Institute for Chemistry) during the years 1939–44 is reported. A.

539.17 : 539.185

1160. The reaction of fast neutrons with N and Ne nuclei. Ortner, G. and Protiwinsky, G. *S.B. Akad. Wiss. Wien*, **148**, *Abt. IIa* (*Nos* 7–10) 349–69 (1939) *In German.*—N and Ne were bombarded with neutrons from Rn–Be and Po–Be sources, and the yield from the nuclear reactions $N^{14} + n^1 \rightarrow B^{11} + He^4$, and $Ne^{20} + n^1 \rightarrow O^{17} + He^4$ investigated with a valve electrometer. Yield maxima were observed at a number of definite energy levels. With N the majority of these energy levels corresponded to the excitation levels of the isotope nucleus N^{15}. V. W. R.

539.172 : 539.185

1161. Delayed neutrons from U^{235} after short irradiation. de Hoffmann, F., Feld, B. T. and Stein, P. R. *Phys. Rev.*, **74**, 1330–7 (*Nov.* 15, 1948).—The decay curve of the delayed neutrons from U^{235}

after an approximately 10 μsec irradiation is measured for times from 0·2 sec to 10 min. This curve is resolved into 5 periods, and their relative intensities are determined. When the data are converted to the conventional case of infinite irradiation, one may represent the decay curve on a relative basis by the following formula where t is in seconds. $N(t) = 0{\cdot}076 \exp(-t/0{\cdot}52) + 0{\cdot}279 \exp(-t/2{\cdot}5) + 0{\cdot}297 \exp(-t/7{\cdot}9) + 0{\cdot}294 \exp(-t/32{\cdot}4) + 0{\cdot}054 \exp(-t/79{\cdot}9)$. Indications of a 6 μsec delayed neutron period are found. These 6 μsec period neutrons seem to amount to only 2% of the delayed neutrons when irradiated to saturation. A.

539.172.1

1162. A direct determination of the energy of the He^3 nucleus from the D — D reaction. ARGO, H. V. *Phys. Rev.*, **74**, 1293–9 (*Nov.* 15, 1948).—The energy of the He^3 nuclei emitted at 90° to the incident deuteron beam in the D + D reaction has been measured directly by deflecting them through a 90°, 15 cm radius, cylindrical electrostatic analyser. The He^3 ions were detected by allowing them to eject secondary electrons from the first plate of a 12-element electron multiplier tube. Thus the ions were not required to traverse any foil or window material between the heavy-ice target and the point of their detection. The corrections to be applied to the electrostatic analyser were experimentally investigated and when applied to the kinetic energies deduced from the observed critical deflecting voltages, give a Q-value of 3·30 ± 0·01 MeV for this reaction. A.

539.172.1 : 539.185

1163. An investigation of the neutrons produced in the deuteron-deuteron reaction. LIVESEY, D. L. AND WILKINSON, D. H. *Proc. Roy. Soc. A*, **195**, 123–34 (*Nov.* 12, 1948).—Some properties of the ${}_1H^2 + {}_1H^2 = {}_2He^3 + {}_0n^1$ reaction are investigated by the photographic plate technique for a bombarding deuteron energy of 920 keV. Thick deuterium targets only are used, and the following quantities measured: (*a*) The Q-value—found to be (3·23 ± 0·02) MeV. (*b*) The neutron spectra at various angles of neutron emission. (*c*) The angular distribution of the neutrons. The problems arising in the application of the technique to the precision determination of neutron energy are discussed and the previous precision determination of the Q value by Bonner is criticized. The present results are in good agreement with the Q value of the reaction ${}_1H^2 + {}_1H^2 = {}_1H^3 + {}_1H^1$ and the maximum energy of the ${}_1H^3$ β-spectrum. The neutron spectra are in accord with those calculated from the ballistics of the reaction and the known excitation function. The neutron angular distribution shows a marked maximum in the forward direction and a minimum at 90° to the deuteron beam. A.

539.172.4

1164. Direct measurement of rare gases produced in uranium fission. New isotope of krypton. SEELMANN-EGGEBERT, W. *Naturwiss.*, **28**, 451–5 (1940) *In German.*—Gases formed in fission reactions are examined by means of a Geiger–Müller counter surrounded by an annular gas space in a brass tube, into which the gases are transferred by means of a stream of air or H_2 after adsorption and desorption from active C. B. A.

539.172.4 : 530.145.6

1165. The mechanism of the two modes of ternary fission in heavy nuclei. DE BOER, J. AND DE GROOT, S. R. *C.R. Acad. Sci., Paris*, **227**, 119–21 (*July* 12, 1948) *In French.*—The production of two range-groups for light particles in fission [see, e.g., Abstr. 747 (1948)] is discussed in terms of a quantized oscillation of the light particle in the Coulomb field of the heavy fragments. A. P. F.

539.172.4 : 539.163.1/2

1166. Ranges in air and mass identification of plutonium fission fragments. KATCOFF, S., MISKEL, J. A. AND STANLEY, C. W. *Phys. Rev.*, **74**, 631–8 (*Sept.* 15, 1948).—Determinations were made of the mean and extrapolated ranges in air of Pu fission fragments for twenty individual masses between 83 and 157. Collimated fission fragments passing through air at 120 or 140 mm pressure were deposited, after being stopped by the air, on a series of 14 thin lacquer films. These were analysed radio-chemically for individual fission products. The corrected activities were plotted against distance traversed by the fragments, yielding differential range curves whose widths at half-maximum were 11·7 ± 1·3%, independent of fragment mass. The activities found beyond each distance were plotted against distance giving integral range curves. Mean and extrapolated ranges were derived from these. In the light group the extrapolated ranges decrease from 2·90 cm (15°c and 760 mm) for mass 83, to 2·25 cm for mass 117; in the heavy group they decrease from 2·25 cm for mass 127, to 1·95 cm for mass 157. From the range-mass curve drawn for well-known masses, definite assignments of 92, 93 and 132 were given to 3·5 hr Y, 10 hr Y and 77 hr Te, respectively. Highly probable assignments of 94 and 134 were given to 20 min Y and 54 min I, respectively. A.

539.172.4 : 539.185

1167. Further experiments on the disintegration of uranium and thorium under neutron bombardment. JENTSCHKE, W. AND PRANKL, F. *S.B. Akad. Wiss. Wien*, **148**, *Abt IIa* (*Nos* 5–6) 237–50 (1939) *In German.*—The nuclear portions produced by the fission of U and Th under n bombardment are investigated by means of an ionization chamber and a valve electrometer with small time constant. An oscillograph or valve counter is used as indicator. 2 main groups of fission particles were found, the larger with a range of 12 mm and the smaller of 20 mm approx. Thermal and fast neutrons were both found effective for fission. The statistical distribution of the fission particles is found; the main groups have energies of 57 MeV and 93 MeV. The fission process is thought to have a half-duration $<10^{-12}$ sec. V. W. R.

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18 : 537.591

1168. On the β-decay of mesons. HOROWITZ, J. J., KOFOED-HANSEN, O. AND LINDHARD, J. *Phys. Rev.*, **74**, 713–17 (*Oct.* 1, 1948).—The β-decay of cosmic-ray

mesons is discussed. The possible process of decay into electron-neutrino plus a neutral particle is treated in some detail. This process is found to fit in well with the familiar formalism of β-decay of atomic nuclei. A comparison is made with present experimental data on mesons. A.

539.18 : 537.591

1169. The capture probability of negative mesotrons. TICHO, H. K. *Phys. Rev.*, **74**, 1337–47 (*Nov.* 15, 1948).—Disintegration curves of positive and negative mesons stopping in H_2O, NaF, Mg, Al and S have been determined. The relative counting rates of positive and negative disintegration electrons support the view that the change of the mean life of negative mesons can be interpreted as due to a competition between the processes of spontaneous disintegration and nuclear capture. The mean-life values of positive mesons in the various materials are in agreement and yield a mean of $\tau_+ = 2{\cdot}11 \pm 0{\cdot}10\ \mu$sec. From the mean life values of negative mesons the capture probabilities in the neighbourhood of the absorber nuclei are calculated and shown to obey an empirical law of the form kZ^a with $a = 3{\cdot}7 \pm 0{\cdot}85$. A.

539.18 : 537.591.3

1170. On the absorption of artificially produced mesons. FERRETTI, B. Letter in *Nuovo Cim.*, **5**, 209–11 (*June*, 1948) *In Italian.*—The author calculates the relative probability of the different modes of disintegration of heavy nuclei (AgBr) by mesons, using evaporation theory. It is shown that the theory is in rough agreement with the observations of Gardner and Lattes. U. C.

539.18 : 539.17

1171. On the conditions and consequences of meson formation. MORAND, M., CÜER, P. AND MOUCHARAFYEH, H. *C.R. Acad. Sci., Paris*, **226**, 1974–6 (*June* 14, 1948) *In French.*—A discussion of the energy and momentum relations of meson formation in simple nucleon-nucleon collisions, in collisions of incident nucleons with complex nuclei and in α-particle-nucleus collisions. J. G. W.

539.185

1172. Phase of scattering of thermal neutrons by titanium. SIDHU, S. S., WINSBERG, L. AND MENEGHETTI, D. Letter in *Phys. Rev.*, **74**, 222 (*July* 15, 1948).—The phase of scattering of thermal neutrons by Ti is determined by comparison of the intensity of X-ray and neutron diffraction from Ti compounds with the NaCl type of structure. It is found that this phase is the same as with H, Li and Mn and is opposite to that occurring with X-rays. J. T.

539.185

1173. Depolarization of neutrons during diffusion. BOROWITZ, S. AND HAMERMESH, M. *Phys. Rev.*, **74**, 1285–93 (*Nov.* 15, 1948).—A theoretical analysis is given of the depolarization to be expected when a plane, monochromatic, polarized beam of thermal neutrons is incident normally on a slab of finite thickness in which the neutrons are scattered isotropically and without capture. The problem reduces to the solution of an integro-differential equation of the Wiener–Hopf type. The equation is solved approximately by a method of G. C. Wick. Experimental possibilities for measuring the scattering amplitudes by this method even in the case where neutron-nuclear forces are not very spin-dependent, are excellent. The case where the capture cross-section is different from zero is also included. A.

539.185 : 530.145

1174. Erratum: A convergent expression for the magnetic moment of the neutron. RIVIER, D. AND STUECKELBERG, E. C. G. *Phys. Rev.*, **74**, 986 (*Oct.* 15, 1948).—See Abstr. 3957 (1948).

539.185 : 537.534.74

1175. Erratum: Neutron-proton scattering at 100 Mev. EISENSTEIN, J. AND ROHRLICH, F. Letter in *Phys. Rev.*, **73**, 1411 (*June* 1, 1948).—Corrections are noted to some numerical values given in an earlier letter [Abstr. 2208 (1948)]. G. J. K.

539.185 : 537.534.74

1176. Elastic scattering of high energy nucleons by deuterons. CHEW, G. F. *Phys. Rev.*, **74**, 809–16 (*Oct.* 1, 1948).—The elastic scattering cross-section of deuterons for neutrons and protons of 90 and 350 MeV has been calculated, using the non-relativistic Born approximation. Two different approaches give roughly the same result: a total neutron-deuteron elastic cross-section of about half the neutron-proton cross-section at the same energy but sharply confined to small angles. The half-width at 90 MeV is about 15° in the laboratory system. The proton-deuteron elastic scattering is similar to the neutron-deuteron for large angular deflections, but at 90 MeV a difference due to the Coulomb repulsion should be noticeable within 10°. It is concluded that the assumption of a simple additivity of nucleon-nucleon cross-sections for light elements is unjustified. A.

539.185 : 539.17

1177. Manufacture of high-yield Po–Be neutron sources. HERNEGGER, F. *S.B. Akad. Wiss. Wien*, **149**, *Abt. IIa* (*Nos* 7–8) 343–7 (1940) *In German.*—A method of producing Po–Be preparations giving high neutron yields. Be discs were cathode sputtered with Pd, and Po was deposited thereon. An increase of 90% was obtained over previous preparations. V. W. R.

539.185.7

1178. The interaction of high energy neutrons and heavy nuclei. GOLDBERGER, M. L. *Phys. Rev.*, **74**, 1269–77 (*Nov.* 15, 1948).—The interaction is studied under the assumption that the nucleus may be described by the statistical model. A detailed study is made of the energy transferred to the nucleus, the angular distribution of emerging particles and the effective cross-section for neutrons passing through nuclear matter. A summary of the results is given. A.

539.185.7 : 539.17

1179. (n, $2n$) process with beryllium with neutrons from a (Poα + Be) source. HOUTERMANS, F. G. *Nachr. Wiss. Göttingen* (*No.* 1) 52–4 (1946) *In German.*—The effective cross-section for the process is calculated to be $(3{\cdot}6 \pm 1{\cdot}0) \times 10^{-24}$ cm². B. A.

STRUCTURE OF SOLIDS 539.2

539.214.9 : 532.517

1180. Contribution to the study of Saint-Venants problem in the elasto-plastic field. PIZZETTI, G.

Comment. Pont. Acad. Sci., **11** (*No.* 1) 1–32 (1947) *In Italian.*—Theory of bending of beams, compression of struts and torsion of cylinders is discussed using Saint Venant's hypothesis that plastic flow occurs when a limiting strain is exceeded. T. S. E. T.

539.215.4 : 533.6.011 : 531.724

1181. The determination of the air resistance of suspended dust particles. BARTH, W. *Z. angew. Math. Mech.*, **25/27**, 157–9 (*Aug.–Sept.*, 1947) *In German.*—The air flows through a cylindrical measuring orifice with rounded edge, and the pressure drop with and without dust in suspension, the volume of air and mass of dust delivered is observed. The method of calculating the additional air resistance due to the dust particles from the observations is explained. On entering the orifice the air velocity increases rapidly, but the dust velocity only slowly due to the inertia of the dust particles. By measuring the air resistance the average size of suspended dust particles can be found. Test results corroborate the mathematical formulae. V. W. R.

539.215.4 : 621.928.3

1182. Dust centrifuge for grain-size analysis. GUSTAVSSON, K. A. *Tekn. Tidskr.*, **78**, 667–70 (*Oct.* 16, 1948) *In Swedish.*—Particles suspended in an air stream moving spirally segregate into (1) those flung to the periphery by centrifugal force, (2) those carried towards the centre owing to friction of air to particle. A centrifuge built on this principle is described. Dust-laden air enters between two rotating parallel discs, and the speed of the air stream determines the critical grain size. Design details are given, errors and their effects are discussed, procedure is described and some results of analysis are given. J. A. W.

539.215.6 : 539.217 : 621.775

1183. Alloying of metal powders by diffusion. WEINBAUM, S. *J. Appl. Phys.*, **19**, 897–900 (*Oct.*, 1948).—In the preparation of alloys by sintering metal powders, the alloy is formed by the diffusion of metals into each other. The distribution of metallic powder in space is expressed by means of a triple series; this series is used to obtain the solution of the diffusion equation. The resulting formula gives the concentration of metal as a function of space, time, temperature and particle size. Sample calculations made for one-to-one atomic proportion Ni–Cu alloys are in general agreement with experimental results. A.

539.217 : 532.782 : 669.018

1184. On the theory of vacancy diffusion in alloys. SEITZ, F. *Phys. Rev.*, **74**, 1513–23 (*Nov.* 15, 1948).—The theory of diffusion in alloys is discussed on the basis of the migration of lattice vacancies in an attempt to interpret the experiments of W. A. Johnson on diffusion in gold-silver alloys. It is assumed that the lattice network preserves its identity during the diffusion even though there is a resultant vacancy current passing through any region. It is also assumed that two types of atom, designated as *A* and *B* atoms, are present in the lattice. The diffusion coefficients are expressed in terms of a function $p(n_{a1}, n_{a2})$ giving the probability that a vacancy in jumping from one atomic plane (designated as plane 2) to a neighbouring plane (designated as plane 1) will interchange places with an *A* atom if there are n_{a1} *A* atoms per unit area of plane 1 and n_{a2} *A* atoms in plane 2. It is found that the chemical diffusion coefficient is related to the function p in a very different way from the diffusion coefficients for radioactive tracers if the latter migrate when no chemical gradient is present. Models of increasing complexity are employed to derive explicit expressions for the function p. It is found that Johnson's experiments can be explained only with the use of models that are more complex than those commonly used. The theory of vacancy diffusion is also employed to interpret the experiments of Smigelskas and Kirkendall concerning the relative displacement during diffusion of fiducial markers placed at the interface between copper and brass. An experiment which could provide an absolute test for vacancy diffusion is proposed. A.

539.217.3/.5

1185. The measurement of permeability characteristics of anodic films on aluminium. BURWELL, R. L., JR. AND MAY, T. P. *J. Electrochem. Soc.*, **94**, 195–213 (*Nov.*, 1948).—A quantitative study of the permeability of anodic aluminium oxide by measurement of rates of diffusion of salts through the film, rates of osmosis using the film as the membrane, rates of water transport through the film, and conductance of the film using salt solutions as electrodes. A.

539.23 : 539.371/374 : 539.382

1186. Elasto-plastic condition of a film. SOKOLOV, A. P. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 1) 33–6 (1948) *In Russian.*—The extension of an unbounded thin film with a circular opening, the edges of which are without external stress, is considered. A method is proposed for determining the equation of the limit of plasticity, or boundary of the elastic domain, and the stresses in the plastic zone. A graph illustrates the distribution of the normal stresses in the zone of plasticity, and the boundary curve of the two states. B. F. K.

539.234 : 539.215.4 : 537.533.73

1187. Electron diffraction study of particle size in thin Bi films deposited by evaporation in vacuum. KEOGH, C. T. AND WEBER, A. H. *J. Appl. Phys.*, **19**, 1077–82 (*Nov.*, 1948).—Electron diffraction patterns of thin Bi films were studied by the method of microphotometer density curve analysis to determine changes of the film structure with ageing and with increase in thickness of the films. All Bi films were deposited on Formvar by evaporation in vacuum. Analysis of the Bi diffraction patterns by comparison with the Formvar pattern as a reference standard indicate that the very thin films (about 20 atom layers or less in thickness) while initially composed of small crystals grow rapidly upon ageing into larger crystals. The very thinnest film (about 5 atom layers thick) analysed exhibited an initial increase in particle size followed by a decrease upon ageing, a somewhat anomalous result requiring further confirmation. Increase in particle size with increase in thickness of the Bi films is observed also, although the results of these latter experiments are somewhat irregular. A.

539.2

1188. An extruding die for powdered X-ray diffraction specimens. GROTENHUIS, M., DURST, G. F. AND BARKOW, A. G. *Non-Destr. Test.*, **7**, 15–18 (*Summer* 1948).—Simple extruding techniques for preparing

pecimens for powder cameras are discussed; they ave some definite advantages, both from the stand-oint of teaching X-ray crystal analysis and the nvestigation of crystal changes produced by high emperature firing techniques, especially in the netallurgical and ceramic field. Powder preparation nd various applications are described in detail. Any combination of unknown powders can be mixed vith a binder and extruded. The finished specimen ods are hard and strong, and can easily be filed in lass tubes. M.-V.

539.26

1189. Commercial and experimental carbon blacks. An X-ray comparison. CLARK, G. L., ECKERT, A. C., R. AND BURTON, R. L. *Industr. Engng Chem.*, **41**, 201–8 (*Jan.*, 1949).—An X-ray diffraction study has been made of 66 carbon black samples for the purpose of classifying many older commercial varieties and those developed during the war. The measurements involved are primarily two interplanar spacings, c for the flat hexagonal basal planes, and a which indirectly measures the carbon-to-carbon distance within a plane; and also two crystallite dimensions, L_c and L_a, in the corresponding directions, derived from the breadths of diffraction interferences. No two carbon blacks give even approximately the same X-ray pattern. A direct relationship has been established between the ratio L_a/L_c, which measures flatness of shape, and ease of processing of channel carbons and structural characteristics. Details are given for various carbon blacks and graphitic acids. One series of experimental carbon blacks is subjected to correlative physical, electron microscope, and X-ray tests. The electron microscope particle is of the order of 25 primary crystallites measured from X-ray data. A.

539.26 : 539.215.2

1190. A technique for quantitative determination of texture of sheet metals. NORTON, J. T. *J. Appl. Phys.*, **19**, 1176–8 (*Dec.*, 1948).—A method is described for making a pole figure of rolled sheet employing an X-ray unit equipped with a G.M. counter for measuring intensities. Small rods are cut from the sheet with their axes parallel to the plane of the sheet and making various angles with the rolling direction. With the counter tube set at the correct diffraction angle for the desired crystallographic plane, each rod in turn is placed in the beam and rotated continuously about its axis. The recorder chart, synchronized with the rod rotation, plots a curve of intensity v. angular position. Thus the record for each rod provides information for a specific diameter of the pole figure and all have a common point at the centre. Since all rods are cylindrical and of the same diameter, there is no absorption correction to be applied. Contours for the pole figures may be drawn as closely together as desired. For special purposes where the complete pole figure is not required but quantitative comparisons are to be made between specimens, certain simplified techniques based on the same principle have proved useful. A.

539.27

1191. Pseudostructures in electron microscope specimens. WATSON, J. H. L. *J. Appl. Phys.*, **19**, 713–20 (*Aug.*, 1948).—Pseudostructures, which are not real properties of electron microscope specimens but are introduced by the action of the electron beam, are described. Examples are given from samples of tetra Cu Ca oxychloride, precipitates from slowly hydrolized $FeCl_3$ solutions and WO_2 to illustrate some of the effects which may occur. The polymorphism of these substances, particularly of the last, is discussed. The major effects which contribute to the pseudostructure formation are melting, evaporation, change of crystalline states, increase in degree of crystallinity and migration of material. The primary cause of specimen changes is to be found in the heating effect of the beam. The possibilities of secondary causes are also considered. Artifacts may also be introduced into bacterial specimens. Observed changes in such samples are described briefly and examples are given. A.

539.27 : 537.533.9

1192. Variations in electron microscope preparations due to electron bombardment. ECKARDT, A. *Optik*, **3** (*Nos* 1–2) 53–8 (1948) *In German.*—An account is given of experiments on the dimensional changes which occur in preparations (small spherical droplets, 10–100 mμ in dia.) mounted on a celluloid base when subjected to electron bombardment (0·04–0·05 mA). The changes are attributed partly to variations in the supporting base and partly to the action of capillary forces in the preparation. The replica type of supporting medium is unaffected by radiation of similar intensity. H. J. H. S.

539.27 : 621.385.833

1193. A review of electron microscope surface technique. MAHL, H. *Optik*, **3** (*Nos* 1–2) 59–67 (1948) *In German.*—The 4 methods in use for the electron microscopy of surfaces, viz. (*a*) direct imagery of a surface which itself emits electrons; (*b*) scanning methods; (*c*) oblique reflection; and (*d*) replica methods are briefly described and their special features and particular applications are pointed out. H. J. H. S.

539.27 : 621.385.833

1194. Summarized proceedings of Conference on Electron Microscopy—London, April, 1948. COSSLETT, V. E. *J. Sci. Instrum. Phys. Ind.*, **25**, 328–31 (*Sept.*, 1948).

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.3 : 531.53

1195. New method for the measurement of the viscosity of metals. SĂLCEANU, C. *C.R. Acad. Sci., Paris*, **226**, 1798–800 (*May* 31, 1948) *In French.*—Results are given for the viscosity of 9 metals obtained by a method using determinations of the log. dec. of a pendulum employing the metal as the suspension. Differences from the results of previous workers are discussed. An attempt is made to determine the influence of temperature. G. O. B.

539.31 : 536.49 : 536.41

1196. The thermal stresses in a body. SCHMEIDLER, W. *Z. angew. Math. Mech.*, **28**, 54–9 (*Feb.*, 1948)

In German.—The stresses in a body subjected to a stationary field of temperature are expressed by 3 partial differential equations. The solution is determined by the fact that the normal and shear stresses are zero at the surface. The problem is reduced to 4 linear integral equations for the cubical expansion and the 3 components of the curl of the displacement vector; and the conditions for the existence of a solution are found. V. W. R.

539.32.08 : 534.113 : 534.37

1197. Experimental determination of Poisson's coefficient by longitudinal vibrations. JATTO, F. Letter in *Ric. Sci. Ricostruz.*, **17**, 1409–13 (*Sept.–Oct.*, 1947) *In Italian.*—An extension of Bordoni's method of electro-acoustic testing of the elastic properties [Abstr. 1092 (1948)] for determining lateral contraction, without need for differently-shaped specimens. A further advantage of the method is that its application is independent of the temperature of the specimen which renders it valuable for questions of physical chemistry as well. The influence of the simultaneous transverse vibrations may be eliminated from the results by well-known and verified methods. When the exciting alternating voltage is purely sinusoidal and symmetrical, the force exerted on the specimen will be sinusoidal and of the first harmonic frequency (as it is $\propto$ square of voltage), whereas an unsymmetrical voltage of a mean value $>$ peak value of the a.c. component produces a force of the fundamental frequency. The frequency differences introduced by the specimen enable Poisson's number to be determined.

539.374

1198. Constant volume deformations with finite strains. MOUFANG, R. *Z. angew. Math. Mech.*, **25/27**, 209–14 (*Nov.–Dec.*, 1947) *In German.*—In the theory of plastic deformation linear and volumetric strains must be differentiated by analogy with Hooke's law of elastic deformation. With infinitesimal linear strains, there is no resultant volumetric strain; but with finite strains the volumetric strain depends on the 3 invariants of the strain tensor. A special tensor, called "strain deviator," which does not give rise to volumetric strain, is developed. It is formed by subtracting a suitable spheric tensor from the strain tensor. The spheric tensor is found by multiplying the unit tensor with a function of 3 tensor invariants determined from a cubic equation. V. W. R.

539.374 : 539.376 : 539.378.3/.6

1199. Deformation of metals in static and in sliding contact. MOORE, A. J. W. *Proc. Roy. Soc. A*, **195**, 231–44 (*Dec.* 7, 1948).—Examination of the contours of the depression in a copper surface made by a cylindrical indenter shows that although considerable bulk deformation has occurred the asperities are relatively little deformed. When a similar groove is made by sliding with a hemispherical slider, there is sufficient surface damage to obliterate completely the surface irregularities. In the presence of a lubricant, similar effects are observed, though on a reduced scale. The tops of the asperities are wiped away, showing that there is considerable interaction between the metal surfaces through the lubricant film. A detailed examination of the surface damage produced during sliding shows that metallic junctions are formed and sheared during the sliding process. These junctions are formed even when the sliding speeds are so small that the temperature rise due to frictional heating is negligible, and it is suggested that they are produced by a cold welding of the surfaces as a result of the high localized pressures developed at the points of real contact. These junctions are often strong enough to rupture the stronger of the two sliding metals. Thus when copper slides on steel (unlubricated) there is not only a marked tearing out of copper fragments from the copper surface, but also a plucking of minute particles of steel out of the steel surface. Further, the shearing of metallic junctions and the smearing of metallic fragments over the surfaces may produce considerable work hardening below the actual points of contact. Although a lubricant reduces the amount of intimate metallic contact, the investigation shows that metallic junctions are formed through the lubricant film by an essentially similar mechanism. These observations provide graphic evidence for the view that the frictional force for both clean and lubricated surfaces is due mainly to the shearing of metallic junctions formed by cold welding at the points of intimate contact. The significance of these conclusions in the burnishing of metals and in the behaviour of bearing alloys is discussed. A

539.374 : 539.43

1200. A method of fitting the Andrade creep equation to experimental results. KENNEDY, A. J. *Proc. Phys. Soc., Lond.*, **61**, 510–15 (*Dec.*, 1948).—A method is described whereby the constants in Andrade's formula, $l = l_0(1 + \beta t^{\frac{1}{3}})e^{\kappa t}$, for the flow of metal under constant stress, can be rapidly deduced from experimental results by direct reading from a system employing sliding templates of calculated shape. The general equation to which the method is applicable is deduced. A

539.379 : 548.0 : 53

1201. Deformation of flat aluminium crystals. RYBALKO, F. P. AND YAKUTOVICH, M. V. *J. Tech. Phys., USSR*, **18**, 915–19 (*July*, 1948) *In Russian.*—Some Al crystals, after extension by 7–15%, exhibit an orientation different from that of the original crystal in a certain region. The crystal, as it were, is divided into two parts differently affected by the deformation. With increasing tensile strain the region referred to becomes ever more sharply delineated, and grows, to occupy in the end about half of the crystal. The relative orientation is changed towards an aspect approaching the formation of "mechanical twin," as previously observed by Elam [Abstr. 691 (1929)]. A

539.4.011 : 66

1202. Corresponding states of metals. LAIKOV, M. A. *J. Tech. Phys., USSR*, **18**, 847–55 (*June*, 1948) *In Russian.*—The mechanical properties of metals are considered, referred to a system of "relative coordinates" which enables the characteristics of a metals to be read off a single curve or determined from a single equation. The equation agrees with test results obtained by the author and other workers. A

539.4.015.1 : 66

1203. Theory of the strength of metals considering their structure. SNITKO, N. K. *J. Tech. Phys*

JSSR, **18**, 857–62 (*June*, 1948) *In Russian.*—A method for determining numerically the yield point of a polycrystalline metal in any state of compound stress, applied to the three lattice groups of α-Fe, Cu and Zn, clearly showing the influence of the structure. The result shows that the Huber–Mises theory furnishes yield point values agreeing approximately only with those obtained by the author for the group of quasi-isotropic, coarse-grained α-Fe (neglecting influence of grain boundaries, and in the range of small plastic deformations). For fine-grained steel and for tempered materials, having different plastic properties, the mechanical application of Huber–Mises' theory is not warranted. A.

539.42 : 536.423.15 : 532.782 : 532.123

Fracture of glasses. *See Abstr.* 872

539.42 : 539.11

1204. Dislocation theory of yielding and strain ageing of iron. COTTRELL, A. H. AND BILBY, B. A. *Proc. Phys. Soc., Lond., A*, **62**, 49–62 (*Jan.*, 1949).—A theory based on the segregation of carbon atoms to form atmospheres round dislocations is developed. The form of an atmosphere is discussed and the force needed to release a dislocation from its atmosphere is roughly estimated and found to be reasonable. The dependence on temperature of the yield point is explained on the assumption that thermal fluctuations enable small dislocation loops to break away; these loops subsequently extend and cause yielding to develop catastrophically by helping other dislocations to break away. The predicted form of the relation between yield point and temperature agrees closely with experiment. Strain ageing is interpreted as the migration of carbon atoms to free dislocations. The rate of ageing depends upon the concentration of carbon in solution and the estimated initial rate agrees with experiment on the assumption that about 0·003% by weight of carbon is present in solution. A.

539.434 : 539.389.3

1205. Plastic flow, creep, and stress relaxation. IV. Anomalous flow as an order-disorder transition. MACK, C. *J. Appl. Phys.*, **19**, 1082–91 (*Nov.*, 1948).—Plastic systems show effects of steric hindrance at rest, which results in a molecule preventing its neighbours from occupying certain positions and introduces a certain degree of orientation. Under stress many more positions, resulting from the rotation, are forbidden to a molecule in motion. In order to make more positions available, the system must increase its volume under stress and changes from a state of greater order to a state of greater disorder. Based on this concept equations are given which present the strain-rate at constant temperatures as functions of stress, change in volume and degree of order and disorder. The changes in entropy and energy of interaction, accompanying the strained state, are expressed by a generalized partition function. This concept of anomalous flow is extended to visco-elastic effects for systems with rubber-like elasticity, and has been exemplified by data on polychloroprene under tension. A.

539.501 : 678.01

1206. Rheology of rubber. RÖSSLER, F. *Zeit. angew. Phys.*, **1**, 50–9 (*March*, 1948) *In German.*—Stress-strain curves, tearing strengths and plastic flow under constant load were measured on test strips of various rubbers at temperatures from −80°C to room temperature. Flow effects were much greater at low temp. and a small elastic after-effect was observed. There was a general similarity between the results for natural and synthetic rubbers. Theoretical explanation of results is suggested. T. S. E. T.

PHYSICAL CHEMISTRY 541

REACTION KINETICS 541.124/.128

541.124/.127 : 542.943

1207. The combustion of methane/air mixtures. AUDIBERT, E. *Fuel*, **27**, 145–54 (*Nov.–Dec.*, 1948).—A theory for the mechanism of combustion of CH_4/air mixtures is developed. Although 4 mechanisms are possible for the combination of CH_4 and O, only one, namely, a branched chain-mechanism, can promote active combustion. This requires the production of propagating centres by an inducing reaction, and it is the development of this reaction which determines whether ignition will occur and not the rise in temperature of the mixture as assumed hitherto. In order to arrest or prevent active combustion it is necessary to inhibit the chain mechanism. A.

541.126 : 531.66 : 662.2

1208. The sensitiveness of solid high explosives to impact. RIDEAL, E. K. AND ROBERTSON, A. J. B. *Proc. Roy. Soc. A*, **195**, 135–50 (*Dec.* 7, 1948).—Oscillographic methods have been used to examine the periods between impact and explosion and impact and rebound in the explosion of several solid high explosives confined between steel surfaces and subjected to the blow of a falling weight. Impact-explosion times up to several hundred μsec were observed, the time increasing with diminishing impact sensitiveness of the explosive and with lower impact energies. The impact-rebound time always exceeded the impact-explosion time in the same experiment. The effect of foreign substances on the times was examined. The mean velocity of blast-wave propagation from explosion was observed to increase with the impact-explosion time. The conditions for the growth of a hot spot in a volume of explosive are formulated in terms of thermal and kinetic data, and critical hot-spot temperatures computed for several explosives show a correlation with impact sensitiveness. A.

541.126 : 536.46

1209. Measurement of the combustion velocity of explosive gas mixtures. MACHE, H. AND HEBRA, A. *S.B. Akad. Wiss. Wien*, **150**, *Abt IIa* (*No.* 8) 157–74 (1941) *In German.*—An improved method of measuring the combustion velocity of explosive gas mixtures by observing the cone of a bunsen arrangement fitted with a suitable nozzle instead of the usual plain tube.

The flow conditions are investigated and found to be still laminar for gas velocities which would cause turbulence with a plain tube. This is advantageous since high gas velocities are required to prevent back-fire. The gas velocities were measured by a micro-manometer filled with toluol and having $\frac{1}{50}$ mm H_2O sensitivity. Results are given for propane and town gas. V. W. R.

ELECTROCHEMISTRY 541.13

541.132/.133.08

1210. The conductivity of aqueous solutions of lanthanum ferricyanide. DAVIES, C. W. AND JAMES, J. C. *Proc. Roy. Soc. A*, **195**, 116–23 (*Nov.* 12, 1948).

541.134 : 537.364

1211. The electrokinetic potential of barium sulphate. BUCHANAN, A. S. AND HEYMANN, E. *Proc. Roy. Soc. A*, **195**, 150–62 (*Dec.* 7, 1948).—The electrokinetic potential of $BaSO_4$, recrystallized from hot concentrated sulphuric acid and subsequently ignited, was investigated against its saturated solution in water by the streaming potential method. The potential is positive and reproducible. The potential of natural barite is also positive but < that of the recrystallized $BaSO_4$. The difference is not due to impurity in the natural $BaSO_4$, but it is more likely to be due to irregularity of the surface and consequent distortion of the lattice of the recrystallized $BaSO_4$. The greater the distortion, the higher is the ζ-potential. The influence of most electrolytes on the potential is completely reversible if there has been contact only at room temperature. Irreversible electrolyte effects are found after prolonged treatment at elevated temperatures. Ba salts and sulphates have a stronger influence on the potential than most other inorganic ions, including multivalent ions such as lanthanum. The potential is a logarithmic function of the activity of the electrolyte solution, but the slope of the curves is smaller than that expected for a thermodynamically reversible electrode. The magnitude of the influence of electrolytes on the potential of recrystallized $BaSO_4$ and of natural barite is very much the same, in spite of the fact that the absolute values of potential of the two types are very different, which is contrary to expectation on the basis of a purely electrostatic theory of ion adsorption. The potential of $BaSO_4$ in its saturated solution cannot be wholly explained by selective adsorption of ions from the solution, but the relative tendencies of the ions to be released from the crystal lattice must be taken into consideration. A.

541.135

1212. Theory of anodic polishing. MERCADIÉ, J. *C.R. Acad. Sci., Paris*, **226**, 1519–20 (*May* 10, 1948) *In French.*—At first sight it seems paradoxical that the dissolution of a metallic anode in an electrolytic bath should not, in general, be accompanied by the polishing of the electrode, i.e. selective disappearance of the micro-unevenness. On the contrary, however, polishing constitutes a very special case, and is attributed to the dissolved metal occurring in ionic complexes which are only slightly dissociated. The products of electrolysis in contact with the anode will be removed by diffusion, and, as a result, it has been shown that the micro-roughness will be subjected to special attack so that polishing becomes possible. The case is described of the dissolution of metal in a sodium phosphate bath for the purpose of polishing Cu and Cd. It has been found that the dissolved Cu or Cd ions are to a large extent combined with the phosphate $(PO_4H_2)^-$ ions. Accessories, such as alcohol and acetic anhydride, which are added to the bath, serve the purpose of reducing its dielectric constant and promote the formation of complexes. H. H. HO

541.135.3 : 621.319.4

1213. On the thickness of the oxide film forming on aluminium during its formation in electrolytes of the 1st group. DERYAGIN, B. V. AND FRIEDLAND, R. M. *J. Tech. Phys., USSR*, **18** (*No.* 11) 1443–8 (1948) *In Russian.*—The problem is important for the production of electrolytic capacitors and rectifiers. The measurements were made by optical methods at varying oxidation potentials. The results show that at least within the range from 5 to 170 V the potential gradient on the film remains constant at $8{\cdot}5 \times 10^6$ V/cm. The dependence of the film thickness on voltage is strictly linear, the maximum thickness obtained at 170 V being 201 mμ. A.

PHOTOCHEMISTRY 541.14

541.14 : 539.164.9

1214. Effect of temperature on the formation of hydrogen peroxide in water irradiated with X-rays and α-particles. BONÉT-MAURY, P. AND LEFORT, M. *C.R. Acad. Sci., Paris*, **226**, 1445–7 (*May* 3, 1948) *In French.*—The formation of H_2O_2 by X-rays in water saturated with oxygen decreases regularly with temperature and shows a sharp discontinuity with change of state at 0°C. It becomes inappreciable at −116°C. Under similar conditions, temperature has no effect on the production of H_2O_2 by α-particles (from radon dissolved in the water) down to −190°C, but the discontinuity at 0°C is still evident. The difference is attributed to the difference in distribution of H and OH radicals in the X-ray and α-particle tracks, the α-particle reaction being predominantly $OH + OH = H_2O_2$. C. B. A.

541.14 : 542.943 : 541.12

1215. A kinetic investigation of the photochemical oxidation of certain non-conjugated olefins. BATEMAN, L. AND GEE, G. *Proc. Roy. Soc. A*, **195**, 376–9 (*Dec.* 22, 1948).

541.14 : 542.943 : 541.12

1216. The determination of absolute rate constants in olefinic oxidations. BATEMAN, L. AND GEE, G. *Proc. Roy. Soc. A*, **195**, 391–402 (*Dec.* 22, 1948).

COLLOIDS . DISPERSE SYSTEMS 541.18/.18

541.1

1217. Measurement of the thixotropy of bentonite suspensions. BARRIOL, J., BLOCH, J.-M. AND KAYSER, F. *C.R. Acad. Sci., Paris*, **226**, 1899–901 (*June*

1948) *In French.*—A novel method is described for measuring thixotropy. Hollow brass tubes are used which are suitably burdened and immersed into the suspension to be measured. The force which the gel can support is related to the depth of immersion by a simple formula. Experiments show that the diameter of the tube has no influence. A comparison is made with the usual method of using a torsional couple and determining the difference between the angular movements of the suspending wire and the immersed plunger. The latter method is more sensitive but requires much more time and care. The results of both methods are in excellent agreement. R. N.

541.182.2/.3 : 539.167.3

1218. Use of radioactive isotopes for investigations of the filtration of ærosols. Born, H. J. and Zimmer, K. G. *Naturwiss.*, **28**, 447 (1940) *In German.*—Experiments on the filtration of tritolyl phosphate clouds have been carried out, using radioactive indicators to show the degree of filtration. The substance was mixed in ethanol solution with H_3PO_4 containing radioactive P, and after sufficient time had elapsed for some exchange of P to take place the substance was atomized and filtered. The degree of filtration was determined by investigating the activity of the filter and the filtrate. B. A.

541.182.3

1219. The physical investigation of certain hygroscopic aerosols. Axford, D. W. E., Sawyer, K. F. and Sugden, T. M. *Proc. Roy. Soc. A*, **195**, 13–33 (*Nov.* 12, 1948).—The general predictions of the Mie theory of light scattering in the range of particle diameters 0·1 to 2·0 μ for transparent spheres have been found to hold good for hygroscopic screening smokes, when a simple treatment of inhomogeneity is used. A critical discussion is given and applied to simple propellant smokes, which have also been studied by sedimentation methods. These have been shown to behave, in general, as hygroscopic smokes, although their chemical nature is much more obscure than for screening smokes. A.

ADSORPTION 541.183

541.183

1220. On the question of method of analysis of processes on non-homogeneous surfaces. Levin, V. I. *C.R. Acad. Sci. URSS*, **59** (*No.* 2) 269–72 (1948) *In Russian.*—A method of obtaining the activation energy distribution function of the activated adsorption from the kinetic adsorption isotherm is proposed, for both constant and variable pressure conditions. 12 references. F. L.

CHEMICAL STRUCTURE 541.4/.6

541.57 : 539.132

Electronic structure of aromatic hydrocarbons. *See Abstr.* 1115

541.654 : 535.323

1221. Effect of chemical composition on relationship between refractive index and Abbe value for binary systems. Sun, K. H. and Huggins, M. L. *J. Amer. Ceram. Soc.*, **28**, 306–7 (1945).—A precise, quantitative way of expressing the dependence on chemical composition of glasses is put forward, and examples of its use, applied to existing data, are given.

CHEMICAL APPARATUS 542.1/.7

542.7 : 578 : 532.5

1222. A new pump. Lewis, L. W. *Rev. Sci. Instrum.*, **19**, 698–700 (*Oct.*, 1948).—A new type of pump is described which has the unique property of being able to move a fluid without change in pressure, volume or temperature. Against a small external resistance, it can be used for pressure, vacuum, or circulation of a gas, and with a simple attachment, liquids may be pumped. A.

CHEMICAL PROCESSES 542.9

542.943

1223. The inflammability of oil mists. Burgoyne, J. H. and Richardson, J. F. *Fuel*, **28**, 2–6 (*Jan.*, 1949).—A study of inflammability characteristics of suspensions in air of mists derived from oils of low volatility, particularly cutting oils not of the "soluble" type. With mists formed by condensation from a saturated vapour/air mixture the lower limit of inflammability on a weight basis is of the same order as expected for the corresponding vapour. The inflammable range, however, seems less for the mist than for the vapour, which is probably associated with the observation actually made that the mist flame is the more easily suppressed by the addition of a particular diluent to the air supporting combustion. The effect of incombustible liquids added to the oil drops was studied in mists mechanically formed at an air jet. The results can be interpreted qualitatively in terms of the thermal capacity of the added liquid and the flame suppressing effect of its vapour. A.

CHEMICAL ANALYSIS 543/545

545.82

1224. Quantitative determination of europium and samarium in fluorites. Merkader, S. *S.B. Akad. Wiss. Wien*, **149**, *Abt. IIa* (*Nos* 7–8) 349–65 (1940) *In German.*—When fluorites are subjected to radiations from Ra their fluorescence-spectrum in filtered ultraviolet light shows characteristic blue and red bands, due to the presence of Eu and Sm. A method of determining the Eu and Sm content from the fluorescence spectrum is explained. The intensities are compared with those due to synthetic calcium fluorite and calcium sulphate preparations containing known concentrations of Eu and Sm. Their fluores-

cence depends on the temperature during manufacture and the duration of the Ra irradiations. V. W. R.

545.82 : 535.37

1225. Uranium determinations with hyalites and other minerals by means of fluorescence analysis. HABERLANDT, H. AND HERNEGGER, F. *S.B. Akad. Wiss. Wien*, **155**, *Abt. IIa* (*Nos* 7–8) 359–70 (1947) *In German.*—The fluorescence spectra of various mineral samples were determined using filtered u.v. light, and the U content determined by comparison with spectra from samples of known U content. A relation between brightness of fluorescence and U content was found with most samples. The blurring or sharpness of the bands of the fluorescence spectrum show whether the mineral has an amorphous or crystalline structure. V. W. R.

545.82 : 537.58

Singularities in light spectrum of oxide cathodes. *See Abstr.* 1082

545.822 : 535.33.072

1226. A new method for the rapid study of chemical reactions by cine-spectroscopy. LAPORTE, M. *C.R. Acad. Sci., Paris*, **226**, 1902–3 (*June* 7, 1948) *In French.*—A detailed discussion of a new cinematograph-spectroscopic method is given, applicable to the study of chemical reactions even of very short duration. It is shown that the concentration of the substance which is the absorbent (of visible, u.v. or i.r. light) is $\propto$ the difference of the photographic densities upon the reference spectra. The determination of variation of concentration as a function of time is obtained with great ease; also the presence of one or more bands characteristic of intermediate products will be revealed during any particular experiment. H. H. HO.

545.822 : 535.33.072

The quantometer, a direct reading instrument for spectrochemical analysis. *See Abstr.* 947

CRYSTALLOGRAPHY 548

548.0 : 537.226

The dielectric constant and its dependence on temperature for crystals of the type of rutile and perovskite. *See Abstr.* 1012

548.0 : 539.373

1227. The phenomenon of artificial displacement. III. STEPANOV, A. V. AND MILKAMANOVICH, E. A. *J. Exp. Theor. Phys., USSR*, **18**, 773–5 (*Sept.*, 1948) *In Russian.*—[See Abstr. 4017 (1948)]. The phenomenon is described for NaCl crystals along the cubic face (100) and in the direction [110]. **IV.** [*Ibid.*, 776–9]. Some more details of the structure of the deformed crystal obtained in investigations by optical methods are given. A.

548.24 : 669.018

1228. Twinning in tetragonal alloys of copper and manganese. WORRELL, F. T. *J. Appl. Phys.*, **19**, 929–33 (*Oct.*, 1948).—Studies have been made of an alloy 88% Mn–12% Cu. This alloy when annealed at 925°c and quenched to room temperature has a tetragonal structure of axial ratio 0·97. It has been suggested that such a structure would show twinning along the 101 and 011 planes. Verification of this suggestion is presented. A.

548.51 : 669.018

1229. Kinetics of precipitation in Al–Zn alloys. BORELIUS, G. AND LARSSON, L. E. *Ark. Mat. Astr. Fys.*, **35 A**, *Paper* 13, 14 *pp.* (1948) *In English.*—The probability of a concentration fluctuation large enough to serve as a precipitation nucleus decreases with increasing values of the second derivative of the free energy with respect to the concentration. Regions where $\partial^2 F/\partial c^2$ has large positive values can be deduced approximately from the equilibrium diagram, and compared with regions where the rate of nucleus formation (as measured by rate of change of electrical resistance with time on annealing) is small. The correlation is good for Al–Zn alloys, as well as the Au–Pt, Pb–Sn and Al–Cu alloys previously investigated [Abstr. 2812 (1945)]. A. J. C. W.

548.527

1230. Ideas on a theory and calculation of the formation of structure in metals on solidification. FROMM, H. *Optik*, **3** (*Nos* 1–2) 137–64 (1948) *In German.*—The factors affecting the rate of formation of nuclei and their rate of growth are discussed and possible expressions for these velocities are deduced. The development of a structure in the metal under different conditions of cooling is analysed mathematically. Numerical examples are given for the case of pure Fe. A. E. DE B.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7 : 537.226

1231. Low frequency dispersion in ionic crystals. BRECKENRIDGE, R. G. *J. Chem. Phys.*, **16**, 959–67 (*Oct.*, 1948).—A new region of anomalous electrical response has been observed at low frequencies in ionic crystals that have been treated to introduce relatively large number of lattice defects. The crystals thus far studied include various alkali halides and AgCl. The effect is attributed to a jumping of the positive ions to vacant lattice sites under the influence of the applied field. This jumping is observed as a relaxation process, producing a change in the dielectric constant which is small and frequently within the limits of error of measurement, and an associated peak in the dielectric loss tangent which is readily measurable. This maximum of tan δ has been studied both as a function of frequency at a fixed temperature and as a function of temperature at fixed frequency. From the magnitude of the peak and

position on the frequency or temperature scales it is possible to calculate the number of lattice defects present in the sample and the activation energy for diffusion U of the positive ion in the crystal. A knowledge of U allows a separation of the activation energy for conduction, $(W/2) + U$, into its components, thus determining W, the activation energy for hole formation. A.

548.7 : 539.153.1

1232. Contraction of the lanthanides and interatomic distances. SARKISOV, E. S. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 3) 371–4 (1948) *In Russian.*—[Cf. *Dokl. Akad. Nauk, SSSR*, **58** (*No.* 7) (1947)]. Continuing former work the author starts from his formula for atomic radii of crystal elements $R = R_H(F/f)^{\frac{1}{3}}$ where R_H radius of H-atom and f is the number of free electrons, or rather "bond electrons." For the elements of sub-group A the latter equals the maximum no. of valence electrons, for sub-group B, $f = 8 - N$. F is the number of electrons of the atom not taking part in the screening of the nuclear field. The formula was obtained by an approximate calculation of the first derivative of the total energy of the crystal lattice in minimum conditions (for which no priority is claimed by the author). However, an improvement of the accuracy was required, as the interaction energy of the electrons in their own field (repulsion between bond electrons, and between these and the other electrons) had been neglected. Owing to the complication of this problem, the function F in the formula had to be accommodated to the experimental facts so as to represent the total effect truly. Its value was found to $F = Z^{\frac{3}{4}}$, where Z = order no. of atom. The calculation of the radii of the metal atoms with the co-ordination no. = 12 showed agreement within $\pm 5\%$ with Goldschmidt's data [*Ber.*, **60**, 1282 (1927)] up to La, for the post-lanthanides within $\pm 10\%$. It follows that the formula is accurate in representing the repulsion effect for those elements in whose atoms the electron occupation with progressing atomic number occurs in the external clouds. The discontinuity of this process in the rare-earth elements because of the downward displacement of their electrons into 4*f*-states understandably produces a lowered repulsion effect. It was established that this decrease amounts to $Z_f^{\frac{3}{4}}$, where Z_f is the number of the deep-lying 4*f* electrons. Thus the formula for these elements $F = Z^{\frac{3}{4}} - Z_f^{\frac{3}{4}}$ which applies from C_e to C_p, where Z_f goes from 1 to 14, to remain at the last value for post-lanthanides. The figures show the surprisingly good agreement between calculated and experimental values. B. F. K.

548.73

1233. Disintegration of silver halide crystals by irradiation with ultraviolet light. KOOY, J. N. AND BURGERS, W. G. *Rec. Trav. Chim. Pays-Bas*, **67**, 21–8 (*Jan.*, 1948).—Crystallographic investigations of powdered preparations of Ag halide crystals exposed to ultraviolet light indicate broadening of the K_α, α_2 doublet and diminution of the discontinuous appearance of the interference lines of the non-exposed crystallites. Irradiation of single crystals of AgCl show the presence of Ag crystallites with preferential orientation. R. H. H.

548.73

1234. X-ray study of the fine texture of Al crystals. GUINIER, A. AND TENNEVIN, J. *C.R. Acad. Sci., Paris*, **226**, 1530–2 (*May* 10, 1948) *In French.*—A simple technique is described, based on the focusing of a divergent polychromatic beam of X-rays after passage through a single crystal plate, which reveals slight variations in orientation of the mosaic elements. This technique is used to study the disorientation existing between the mosaic elements of a single crystal of Al submitted to various treatments. J. T.

548.73 : 537.312.5 : 541.14

1235. Influence of cadmium and lead halides on the photosensitivity of silver halides. BURGERS, W. G. AND KOOY, J. N. *Rec. Trav. Chim. Pays-Bas*, **67**, 16–20 (*Jan.*, 1948) *In English.*—Debye-Scherrer patterns of mixed crystals of AgBr with a few % of $PbBr_2$, and of AgCl with a few % of $CdCl_2$ showed no change in lattice parameter compared with the pure halides. An increase of ionic conductivity as compared with pure halides was shown by Koch and Wagner [*Z. Phys. Chemie B*, **38**, 295 (1938)]. The marked decrease of photosensitivity (colouring on exposure to u.v. light), as compared to that of the pure halides, indicate that mixed crystals were formed. An interpretation in connection with Gurney and Mott's theory of latent image formation is given. R. H. H.

548.73 : 541.57

1236. Structure of the dinitrosulphite ion. COX, E. G., JEFFREY, G. A. AND STADLER, H. P.; EVANS, M. G. AND GERGELY, J. Letter in *Nature, Lond.*, **162**, 770–1 (*Nov.* 13, 1948).—The compound $K_2SO_5N_2$, formed by the absorption of nitric oxide by alkaline potassium sulphite, is found to be isomorphous with the corresponding Tl and NH_4 salts, and this has enabled its structure to be determined by direct X-ray crystal analysis independently of any preconceived formulation; it is found that the S atom and the N_2O_2 group lie in one plane, and that the bond angles are $\sim 120°$. This, together with the short N–N distance of 1·30 Å, implies that a double-bond exists between the N atoms with trigonal (Sp^2) hybridization. It invites comparison with the structure of dimethyl nitramine. Both the N–O distances of 1·36 Å correspond to a bond-order of $\sim 1 \cdot 2$. Evans and Gergely indicate that the orbitals of the N attached to the S atom correspond in bond formation to a hybridization of the type $(1s)^2(2p)^2(2s2p)^3$ rather than to $(1s)^2(2s)^2 2p_x 2p_y 2p_z$. Molecular orbital, charge densities and bond-order calculations are included, and compared with the experimental values of Cox *et al.* Strong double bond character is revealed in both the NN and NO bonds. H. H. HO.

548.733

1237. Camera for structural analysis with rotating collimator and flat cassette and its application. GOGOBERIDSE, D. B. *J. Tech. Phys., USSR*, **18**, 823–6 (*June*, 1948) *In Russian.*—A description of the camera is given, together with specimen diagrams from which the obvious advantages of the rotating collimator in work with coarse-crystalline substances can be seen. A.

548.733

1238. X-ray spectrometer with Geiger counter for measuring powder diffraction patterns. BLEEKSMA, J., KLOOS, G. AND DI GIOVANNI, H. J. *Philips Tech. Rev.*, **10**, 1–12 (*July*, 1948).—With the spectrometer described, X-ray diffraction patterns are traversed by a G.M. counter instead of being recorded on photographic film. The G.M. tube is applied in a well-known focusing arrangement making use of a large flat specimen. Due to the extremely high sensitivity of the counter tube, to the high apparent X-ray "brightness" of the focal spot which is used at a glancing angle of only 1·5°, and to the large specimen surface contributing to the diffraction intensity, an X-ray tube rating as low as 125 W is sufficient. The intensity of the diffraction lines is measured, (*a*) by counting the current pulses produced in the G.M. tube by the entering X-ray quanta, a scaling circuit making this possible at radiation intensities of several thousand quanta per second at the tube window, or (*b*) by measuring, after amplification, the mean value of the current through the G.M. tube by means of a milliammeter, whose reading can be automatically recorded while the spectrum is being scanned, thus producing a chart which immediately indicates the relative line intensity as a function of the diffraction angle. The scanning speed, as well as the averaging time for the mean current measurement, can be chosen between wide limits. The accuracy of the determination of diffraction angles and relative intensities, and the resolving power for adjacent diffraction lines are better than with the commonly used photographic methods, under comparable electric and geometric conditions. A.

548.733

1239. A temperature-controlled Frevel focusing X-ray powder camera. VAND, V. *J. Appl. Phys.*, **19**, 852–5 (*Sept.*, 1948).—The camera described is suitable for the study of large cells of organic crystals. It uses a convergent X-ray beam collimated by a multiple slit system and records transmitted reflections only. A.

548.733 : 537.531 : 535.4

1240. Divergent beam X-ray photography with standard diffraction equipment. GEISLER, A. H., HILL, J. K. AND NEWKIRK, J. B. *J. Appl. Phys.*, **19**, 1041–9 (*Nov.*, 1948).—A new method for preparing divergent beam X-ray photographs of crystals is presented. This employs the usual Laue transmission camera and a collimated primary beam of X-rays. Fluorescent radiation originating either in the crystal sample or at a radiator in front of the crystal is used as the source of divergent X-rays. Some applications of the technique to determinations of orientation, lattice parameters and crystal perfection are illustrated. A.

548.733 : 669.018

1241. X-ray analysis of the ageing of aluminium alloys. BAGARIATSKI, Y. A. *J. Tech. Phys., USSR*, **18**, 827–30 (*June*, 1948) *In Russian.*—Description of a monochromator with bent quartz for hard radiation. Diffraction diagrams of monocrystals of the alloys Al–Cu and Al–Cu–Mg taken with monochromatic radiation are given, together with some conclusions drawn from their evaluation. A.

548.734 : 537.531

1242. Erratum: Achromatization of Debye–Scherrer lines. EKSTEIN, H. AND SIEGEL, S. Letter in *Phys. Rev.*, **74**, 625 (*Sept.*, 1948).—See Abstr. 3530 (1948).

548.734.26

1243. Use of Laue reflection method for the determination of the orientation of the crystallographic axes of blocks of quartz. HUOT DE LONGCHAMP, M. AND MARTIN-SAVARY, H. *C.R. Acad. Sci., Paris*, **227**, 134–6 (*July* 12, 1948) *In French.*—The method, briefly described, is applicable to crystals of thickness > can be used in the Laue transmission method. The spots are not diffuse and the method enables the orientation of blocks of quartz to be determined rapidly and with sufficient accuracy for piezoelectric purposes. A. J. M.

548.734.842

1244. Electron density of nickel. AGEYEV, N. V. AND GUSEVA, L. N. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 1) 65–6 (1948) *In Russian.*—The atomic scattering factor of Ni has been determined experimentally by the photographic method, using Co and Cu X-rays. The electron density was calculated from that factor. The results show that "bridges" with increased electron density are formed between Ni atoms, each bridge uniting the atom with one of the 12 neighbour atoms. The electron density of the bridge is 1·1 electron/Å^3, as compared with the figure of 0·4 electron/Å^3 for the interionic space. F. L.

548.734.842

1245. Distribution of the electron density in the metal lattice of copper. KRITSKAYA, V. K. AND ROVINSKI, B. M. *J. Exp. Theor. Phys., USSR*, **18**, 785–9 (*Sept.*, 1948) *In Russian.*—The possibility of using Fourier expansions for obtaining a quantitative picture of the electron density distribution in the crystal lattice of metals was investigated. The curves of electron density distribution in the metal lattice of Cu were obtained in the 3 directions [100], [110] and [111]. It appeared that the "theoretical temperature" introduced in the form of a factor $\exp(-\beta\Sigma h^2)$ introduces a considerable distortion into the results. In the general case the method supplies a qualitative picture of the distribution of the electron density, and in special cases, such as the one investigated, even a quantitative representation. A.

548.735.44

1246. Some relations between the *F*'s and *F*^{2}'s of X-ray diffraction. BUERGER, M. J. *Proc. Nat. Acad. Sci., Wash.*, **34**, 277–85 (*June*, 1948).—Outlines a method of finding the relationships between the Fourier coefficients of the implication function and the electron density function, and applies the results to the determination of phases in crystal structure analysis. J. T.

548.736.42

1247. Crystal structure of α-sodium hydroxide. ERNST, T. *Nachr. Wiss. Göttingen* (*No.* 1) 76–8 (1946) *In German.*—The crystal structure of the low-temp. modification of NaOH has been determined; it has a $3{\cdot}39_7 \pm 0{\cdot}03$, b and c $11{\cdot}3_2 \pm 0{\cdot}05$ Å; 4 molecules per unit cell; ρ 2·02; space-group D_{2h}^{17}. The ionic radius of OH′ is 1·40 Å. B. A.

548.74 : 548.33

1248. Transformations in organic pigments. HAMM, F. A. AND VAN NORMAN, E. *J. Appl. Phys.*, **19**, 1097–109 (*Dec.*, 1948).—Electron microscope examination showed that Cu phthalocyanine and indanthrene blue RS can be recrystallized into crystals of a different structure and colour, and are therefore at least dimorphic. The transformations can be observed while taking place in the electron microscope. A.

GEOPHYSICS 55

550.312 : 531.51

1249. The discontinuities of the 2nd derivatives of the gravity potential at discontinuities of the density. ENTEL, H. *Z. angew. Math. Mech.*, **25/27**, 186–9 (*Oct.*, 1947) *In German.*—The paper investigates how the 2nd derivatives of the gravity potential vary when there are discontinuities in the density of the body in a normal direction. The components of the 2nd derivatives in 2 arbitrary directions are given as a function of the change in density. V. W. R.

551.463 : 535.43

Radiation theory of the hydrosphere. *See Abstr.* 969

ATMOSPHERE . METEOROLOGY 551.5

551.508.94 : 551.594.11

1250. A radio-sonde method for atmospheric potential gradient measurements (corrigendum). BELIN, R. E. *Proc. Phys. Soc., Lond.*, **61**, 571 (*Dec.*, 1948).—See Abstr. 1370 (1948).

551.509.1 : 621.397.9

1251. Televising of meteorological information. CLAUSSE, R. *Onde Élect.*, **28**, 358–60 (*Oct.*, 1948) *In French.*—Abstr. 605 B (1949).

551.510.535 : 621.396.11

1252. On the structure of the ionosphere. MALSCH, J. *Arch. elekt. Übertragung*, **2**, 58–69 (*Feb.–March*, 1948) *In German.*—Short period fluctuations in the amplitude of ionospheric reflections are considered. It is assumed that irregularities in the lower part of region *E* (or in a lower layer) give rise to interference between rays of differing path lengths and thus to the observed fading in the received signal. The influence of such fading and of diffraction effects in normal incidence measurements of pulse amplitudes are briefly considered. W. J. G. B.

551.521

1253. Total radiation of clouded and cloudless sky. KALITIN, N. N. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 4) 579–81 (1948) *In Russian.*—Whilst direct solar radiation has been well covered by research, and scattering of solar radiation in the atmosphere a good deal, their summed effect (total radiation) has not received sufficient attention. The paper reports on measurements of the latter, using data obtained between 1931 and 1940 at Pavlovsk, near Leningrad. Direct radiation was originally registered on a thermo-electric actinograph, diffuse radiation on a piranograph, total radiation on a solarograph, so that the measurements could be checked mutually. It was found that there were only 79 totally cloudless days within 10 yr (2%), and they were quite fortuitously spread over the months. Thus the materials on cloudless days had to be supplemented by taking cloudless half-days (mornings and afternoons) into account; this supplied another 131 half-days for 10 yr. The total yearly incident energy for cloudless days was found as 121·7 kg.cal/cm², 83% of which was due to direct radiation, and 17% to diffuse radiation. Of the possible maximum of energy only 37% reach the ground in November (the worst month), and 67% in June (best month), which gives a fair picture of the absorption of radiation in clouds. The solar radiation has the greatest constancy of all the component factors, as its maximum deviation is only 9%, the corresponding values for total radiation and diffuse radiation being 13% and 23% respectively. B. F. K.

551.55 : 621.396.9

1254. Meteorological radio direction finding for measurement of upper winds. KIRKMAN, R. A. AND LEBEDDA, J. M. *J. Met.*, **5**, 28–37 (*Feb.*, 1948).—The course of development of Army radio equipment at the Signal Corps Engineering Laboratories for the measurement of upper wind velocities is reviewed. It is indicated that this type of information is needed for the successful navigation of aircraft, for weather predictions and for the determination of ballistic winds used in connection with artillery fire. Operation of the two latest types of direction-finders, for upper wind measurements up to 100 000 ft altitude, is described in some detail. Performance data are given. Sources of error in connection with accuracy measurements are discussed quantitatively. Standard angular errors of the apparatus considered are in the range from 0·05 to 0·15 degrees. A.

551.577 : 621.396.9

1255. Measurement of rainfall by radar. MARSHALL, J. S., LANGILLE, R. C. AND PALMER, W. McK. *J. Met.*, **4**, 186–92 (*Dec.*, 1947).—Experiments at wavelength 10 cm have verified the theoretical finding that the power obtained from radiation reflected from rain is $\propto Z$, the sum of the sixth powers of diameters of raindrops contained in a representative volume. No value has been obtained for the constant of proportionality. Correlation of Z with rainfall intensity R (both at ground level) on logarithmic scales shows that, within a factor of about 2, $Z \propto R^2$. Vertical scans of rain storms by radar indicate that variation of rain content with height is moderate and accountable. It may be possible therefore to determine with useful accuracy the intensity of rainfall at a point quite distant (say 100 km) by the radar echo from that point. A.

551.593 : 523.755

The light of the night sky. *See Abstr.* 833

BIOLOGY 57/59

578 : 621.317.39 : 531.787.9

Measuring physiological phenomena using the electrical strain gauge. *See Abstr.* 871

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

614.485 : 621.327.43

1256. The ultra-violet radiation of fluorescent lamps and its biological consequences. LATARJET, R. *Rev. Opt. (Théor. Instrum.)* **27,** 333–8 (*June,* 1948) *In French.*—Abstr. 775 B (1949).

615.849 : 621.384.6

1257. Development of the betatron for electron therapy. SKAGGS, L. S., ALMY, G. M., KERST, D. W. AND LANZL, L. H.; UHLMANN, E. M. *Radiology,* **50,** 167–73 (*Feb.,* 1948).—Use of fast electron beam offers advantages, since the ionization is at the deep seated regions and the intervening superficial tissues are relatively unaffected. Details of a 22 MV betatron used for this purpose at the University of Illinois are given with illustrations. The use of an Al instead of a glass window produces less absorption and results in a greater penetration of the electron beam from its source. Penetration of the beam was determined by films, after passage through presd wood, and penetrations up to 6 cm have been obtained. Depth dosage has not yet been measured, but the exit dose is small. For collimation of the electron beam Pb is unsuitable owing to emission of radiation and low hydrocarbon bodies like wood and plastics are preferable. Considerably more investigation will be necessary before clinical use of the apparatus is possible. B. J. L.

PHOTOGRAPHY 77

778.33 : 621.386.542 : 389.6

1258. Sizes of X-ray film and intensifying screens. *Brit. Stand.* (*No.* 1443) 7 *pp.* (1948).—Describes sizes for medical and industrial uses; min. internal sizes for cassettes intended to receive X-ray film and screens are specified. A.

778.5 : 621.397

1259. Motion picture photography of television images. FRASER, R. M. *RCA Rev.,* **9,** 202–17 (*June,* 1948).—Permanent recording of television programmes for documentary purposes and as an aid to networking may be accomplished by motion picture photography of the image. Apparatus and methods developed are described. Development is traced from the first attempts in 1938 through the experimental cameras to the commercial camera system now in use. The 16 and 35 mm equipment, kinescope phosphors and film spectral characteristics, resolving power of films, exposure of film, processing and printing of kinescope film, the photographic monitor and sound recording are discussed. A.

778.5 : 621.397.9

1260. Film recording methods by means of television. DELBORD, Y. L. *Onde Élect.,* **28,** 366–8 (*Oct.* 1948) *In French.*—Abstr. 606 B (1949).